

NAVSHIPS 900,000.1

0967-000-0010

NON-REGISTERED

**ELECTRONICS INSTALLATION
AND
MAINTENANCE BOOK

COMMUNICATIONS**

**DEPARTMENT OF THE NAVY
BUREAU OF SHIPS**

CHAPTER 1

COMMUNICATIONS EQUIPMENT

PAGE NUMBER AND TITLE	CHANGE IN EFFECT	PAGE NUMBER AND TITLE	CHANGE IN EFFECT
TITLE PAGE	Original	AN/SRC-18	
ii-iv Effective Pages	Original	AN/SRD-7:1	Original
v Preface	Original	AN/SRR-4:1	Original
vi Correction Page	Original	AN/SRR-11:1-2	Original
vii Table of Contents	Original	AN/SRR-12	
		AN/SRR-13	
		AN/FRR-21	
1 through 54 Communications Chapter	Original	AN/FRR-22	
		AN/FRR-23	
Title Page - Service Notes	Original	AN/SRR-13:1	Original
1-SN-1 through 1-SN-47	Original	AN/SRT:1	Original
AM-215/U:1-2	Original	AN/URT	
AN/ARC-1:1-10	Original	AN/SRT-14:1-4	Original
AN/ARC-27:1	Original	(Also see AN/URT-2 and	
AN/CRT-3:1	Original	AN/URT-3)	
AN/FCC-3:1-2	Original	AN/SRT-15	
AN/FGC-1:1	Original	AN/SRT-16	
AN/FGC-5:1	Original	AN/SRT-15:1	Original
AN/FGC-9:1	Original	(Also see AN/URT-2 and	
AN/FMQ-2:1	Original	AN/URT-3)	
AN/FRA-501:1	Original	AN/SRT-16	
AN/FRC-6:1	Original	AN/SRT-16 (See AN/URT-2	
AN/FRR-21, 22, 23	Original	and AN/URT-3)	
(See AN/SRR-11)		AN/SSQ-14:1	Original
AN/FRR-28:1	Original	AN/TGC-1:1	Original
AN/FRT-5:1-3	Original	AN/TSA-11:1	Original
AN/FRT-6		AN/TXC-1:1-2	Original
AN/FRT-6:1	Original	AN/UGH-1:1	Original
AN/FRT-15:1	Original	AN/UNQ-7:1	Original
AN/FRT-24:1	Original	AN/UPN-12:1	Original
AN/FRT-25:1	Original	AN/URA-8:1-4	Original
AN/GRC-27:1	Original	AN/URC-16:1	Original
AN/PRC-6:1	Original	AN/URC-32:1-9	Original
AN/PRC-8:1-2	Original	AN/URD-4:1	Original
AN/PRC-9		AN/URN-3:1	Original
AN/PRC-10		AN/URN-12:1	Original
AN/SGC-1:1-5	Original	AN/URR-13:1-2	Original
AN/SIC-1:1	Original	AN/URR-21:1	Original
AN/SRA-3:1	Original	AN/URR-35:1	Original
AN/SRA-9:1	Original	AN/URT (See 4N/SRT:1)	
AN/SRA-12		AN/URT-2:1-2	Original
AN/SRA-12:1	Original	AN/URT-3	
AN/SRA-13:1	Original	AN/URT-4	
AN/SRA-14		AN/SRT-14	
AN/SRA-15		AN/SRT-15	
AN/SRA-20:1	Original	AN/SRT-16	
AN/SRA-22:1	Original	AN/URT-3:1	
AN/SRA-23(XN-1):1	Original	AN/URT-4	Original
AN/SRC-10:1	Original	AN/SRT-15	
AN/SRC-11		AN/SRT-16	
AN/SRC-12		AN/URT-7:1	Original
AN/SRC-13		AN/VRC-2:1	Original
AN/SRC-14		AN/VRC-16:1	Original
AN/SRC-15		AN/WRA-1:1	Original
AN/SRC-16		AN/WRT-2:1	Original
AN/SRC-17		AS-390/SRC:1	Original

CHAPTER 1 (Cont'd)

COMMUNICATIONS EQUIPMENT

PAGE NUMBER AND TITLE	CHANGE IN EFFECT	PAGE NUMBER AND TITLE	CHANGE IN EFFECT
AS-668/SR:1	Original	RCU:1	Original
AS-768/GR:1	Original	RD-92/UX:1	Original
AT-317/BRR:1	Original		
BA-403/U:1	Original	RD-115/UN:1	Original
BC-348:1-3	Original	RD-119/UN	
BC-610:1	Original	RD-133/UN:1	Original
BC-639:1	Original	RDM:1	Original
BC-640:1-2	Original	RDO:1	Original
BC-1016:1	Original	RDZ:1-3	Original
BD-100:1	Original	RT-66/GRC:1	Original
C-1004A/SG:1	Original	SB-82/SRR:1-3	Original
C-1456/BRC:1	Original	SB-83/SRT:1	Original
CU-168/FRR:1	Original	SB-315/U:1	Original
CU-332A/UR:1	Original	SB-346/S:1	Original
CU-737/URC:1	Original	SB-440/SP:1	Original
CV-172/U:1	Original	SB-441/SP	
CX-1846/U:1	Original	SB-442/SP	
H-169/U:1	Original	SB-467/FG:1	Original
KWS-1:1	Original	SB-470/FG	
KY-43/URT:1	Original	SCR-299:1	Original
LM:1	Original	SCR-300:1	Original
M-58/U:1	Original	SCR-508:1-3	Original
MAM:1	Original	SCR-509:1-2	Original
MAN:1-2	Original	SCR-522:1	Original
MAR:1-4	Original	SCR-608:1	Original
MBF:1-3	Original	SCR-610:1	Original
MK-260/U:1	Original	SCR-624:1	Original
MN:1	Original	SG-354/U:1	Original
MO-1/MAK:1	Original	SSB-1:1	Original
MOD-14:1	Original	T-347/SRT:1	Original
MOD-15		T-410/FRC:1	Original
MOD-19		TAB-7:1	Original
MOD-15:1	Original	TAJ:1-2	Original
MOD-19		TAQ:1	Original
MOD-19:1	Original	TBA:1	Original
MOD-28:1	Original	TBK:1-9	Original
MP-48:1	Original	TBL:1-7	Original
MX-1743/SRC:1	Original	TBM:1-3	Original
OBQ-1:1	Original	TBS:1-9	Original
R-390A/URR:1	Original	TBW:1	Original
RAK:1-2	Original	TBX:1-2	Original
RAL:1	Original	TCC-3:1	Original
RAO:1	Original	TCK:1-4	Original
RBA:1-2	Original	TCO:1	Original
RBB:1-3	Original	TCP:1	Original
RBC:1-2	Original	TCS:1-7	Original
RBG:1	Original	TCZ:1-2	Original
RBH:1-2	Original	TDD:1	Original
RBK:1	Original	TDE:1-10	Original
RBL:1	Original	TDH:1-4	Original
RBM:1	Original	TDN:1-2	Original
RBO:1-2	Original	TDO:1	Original
RBS:1	Original	TDQ:1-4	Original
RBU:1	Original	TDT:1	Original
RCH:1	Original	TDZ:1-9	Original
RCK:1-3	Original	TEB:1-2	Original

EFFECTIVE PAGES**NAVSHIPS 900,000.1****FRONT MATTER****CHAPTER I (Cont'd) -****COMMUNICATIONS EQUIPMENT**

PAGE NUMBER AND TITLE	CHANGE IN EFFECT	PAGE NUMBER AND TITLE	CHANGE IN EFFECT
TED:1-4	Original	TT-23/SG:1-2	Original
TEF:1	Original	TT-47/UG:1-18	Original
TN-197/URT:1	Original	TT-50/UG:1	Original
TN-229/SRT:1	Original	TT-71/UG:1	Original
TN-230/BRT:1	Original	NT-11UG/12UF:1	Original
TN-249/BRT:1	Original	NT-23211:1	Original
TPA:1-2	Original	NT-23496:1-2	Original
TS-297/U:1-3	Original	NT-23497:1	Original
TSEC/HW-10:1	Original	NT-49131:1-5	Original
TSEC/HW-19A:1	Original	NT-49545:1	Original
TSEC/KD-6A:1	Original	NT-49620:1-2	Original
TSEC/KW-22:1	Original	NT-51007A:1	Original
TSEC/KW-26:1	Original	NT-66089:1	Original
TSEC/KW-37:1	Original	NT-66095:1	Original

PREFACE

The Electronics Installation and Maintenance Book (EIMB), NAVSHIPS 900,000, provides subordinate policies, installation and maintenance standards, and procedures required to implement the policies of Chapter 67 of the Bureau of Ships Technical Manual.

The EIMB is published for the guidance of all personnel in the naval establishment in accordance with articles 67-2 and 67-55 of the Bureau of Ships Technical Manual.

Change 29, issued 31 August 1961, reorganized the EIMB into seven chapters. One chapter contains general information, five chapters contain general information and service notes pertaining to specific types of equipment, and one chapter comprises the Field Change Identification Guide (FCIG). As a further step in this reorganization, each chapter of the EIMB is being reissued as a separate item of supply with its own decimal NAVSHIPS number.

The Communications Chapter of the EIMB, NAVSHIPS 900,000.1, is in effect upon receipt, superseding Changes 26, 27, and the following pages of Change 29:

1. EIMB - Communications Title Page
2. Effective Pages and Contents, pages 5-ii, 5-iiA
3. Communications Chapter, pages 5-1 through 5-54
4. Service Notes Title Page - Communications

Activities should submit comments and recommendations regarding this publication to Chief, Bureau of Ships (Code 695D3).

Activities should submit requisitions for additional copies of this publication to Naval Supply Depot, Philadelphia, Pennsylvania.

Activities not already on the distribution list for the EIMB should submit requisitions for this publication to Chief, Bureau of Ships (Code 248).

[illegible]

CHAPTER 1

COMMUNICATIONS EQUIPMENT

PARAGRAPH		PAGE
1-1	Introduction	1
1-2	Checking Communications Systems	8
1-3	Power Supplies	10
1-4	Teletype Equipment	12
1-5	Remote Control Units	16
1-6	Transmitting Equipment	19
1-7	Receivers	33
1-8	Terminal Equipment	48

1-1 INTRODUCTION

PURPOSE.

The purpose of this chapter is to provide general reference material which will aid in maintaining naval communication equipment. Installation data is specific for each equipment and, therefore, is obtained from the appropriate instruction book and the Service Notes section of this chapter.

The equipment described includes all forms of units used for radio communication: transmitters, receivers, teletype and facsimile equipment, terminal equipment for teletype and facsimile equipment, and power supplies and remote control units for all the foregoing.

SCOPE

The material in this chapter takes the form, for each type of equipment, of:

- A description of the basic principles of operation, which is needed for application of the troubleshooting procedures.
- A description of the configurations of functions within the equipment.
- Description and location of adjustments commonly found.
- A preliminary troubleshooting outline, for use in checking the more easily overlooked causes of trouble and to determine the general area in which the malfunction is located.
- A troubleshooting procedure for each general area of the equipment and type of complaint.

TROUBLESHOOTING

The electronics technician is urged to analyze each failure to determine its possible causes before attempting to repair a malfunctioning equipment. This step, which should precede removal of the equipment from its cabinet, includes the following:

- Equipment operation should be tested in all modes and with the use of all functions to permit the malfunction to be described completely.
- The performance data obtained should be analyzed, with the use of the equipment schematic or block diagram, to determine what specific functions, if impaired, would result in the symptoms noted.
- Finally, the specific components, which if failed could result in the impairment of the function noted, should be listed.

Many technicians need no instruction to perform these steps, but an outline of the preliminary troubleshooting steps will be useful to the less experienced technician.

More specific troubleshooting procedures are then used to identify the failed component. These, too, might be performed by the experienced technician without specific instructions, but the troubleshooting procedures given will be useful to less experienced technicians. The use of these techniques will save time and money, improve equipment conditions, and improve technical competence.

SAFETY

Hazards encountered in servicing electronic equipment and the precautions to be taken against them are covered thoroughly in electronic technicians training courses, Chapter 1 of the EIMB, and the Navy Safety Manual. These sources should be referred to in case of any doubt about safety precautions to be observed in troubleshooting.

Observance of safety precautions will help keep equipment operating, help your career in the Navy, and possibly determine whether you survive. Follow them!

TYPES OF EMISSION

Understanding the operation and servicing of communication equipment depends to a large extent on understanding the types of radio emissions used. These are tabulated completely in the EIMB appendix; the commonly used emissions are described following.

AM EMISSIONS. A continuous, unmodulated, fixed-frequency radio signal (AO emission) carries no information. The signal must be modulated by another frequency or waveform in order to convey information.

In CW communication, the carrier is present only during coded intervals, as shown in figure 1-1. Such an A1 emission requires a higher degree of operator skill, but uses less complex equipment and is capable of reliable reception over greater distances than other types of emission.

A3 transmission is the radiation of R-F energy which has been amplitude modulated by an audio signal carrying the desired intelligence. A-M voice or "phone" transmissions use this type of emission, as do MCW (A2 or keyed audio-modulated CW), some teletype, and multiplexed voice and/or teletype transmissions.

SINGLE-SIDEBAND EMISSIONS. Although an amplitude-modulated signal is usually pictured as R-F waves within a modulation envelope, as shown in figure 1-1, it is more usefully described in terms of frequency distribution in figure 1-2. This shows the single-tone, amplitude-modulated R-F signal to actually consist of simultaneous transmission of the carrier (f_0), a lower side frequency ($f_0 - f_m$), and an upper side frequency ($f_0 + f_m$), where f_m is the modulating frequency of the carrier (f_0), a lower side frequency ($f_0 - f$), and an frequency. The beat frequency between the carrier and one or both side frequencies (figure 1-3) is detected and amplified by the receiver to reproduce the audio modulating tone. The carrier frequency can be modulated by more than one audio frequency at a time. Voice-modulation of the R-F signal by frequencies between 100 and 2000 cps, for example, would produce two sidebands rather than two side frequencies. These 1900 cps wide sidebands are shown in figure 1-4. The shape of the sidebands varies from instant to instant with changes in the frequency composition of the modulating voice signal. Conventional A-M phone transmissions result in such frequency distributions.

Two-thirds of the total amplitude-modulated power is in the carrier under perfect conditions, as shown in figures 1-5 and 1-6, and only one-sixth in each side frequency or sideband. However, actual A-M voice transmissions never attain this theoretical efficiency figure (100% modulation).

In practice, each sideband contains perhaps a tenth of the total transmitted power during modulation. The carrier continues at two-thirds of the total maximum power even when no information is being transmitted, such as during pauses between words and sentences.

Single-sideband techniques permit substantial savings in transmitter cost, size, and power consumption for a given information-carrying power. Only one sideband is emitted and only in the presence of a modulating signal. More important, no carrier at all is emitted in SSB transmission. The receiver generates a local frequency which is injected with the sideband signal to take the place of the carrier; the difference frequencies resulting from the heterodyning action are the audio components of the modulation. Such transmissions (A3a emission) occupy less than half the spectrum space of a conventional A-M transmission, relieving the crowded conditions and interference in the radio spectrum.

F-M EMISSIONS. Figure 1-7 shows an R-F waveform which abruptly changes in frequency at regular intervals,

while remaining constant in amplitude. This frequency-modulation technique is known as F1 emission; it is used for FSK (frequency-shift keying) transmission of teletype messages.

An R-F emission that is frequency modulated by a single audio tone will produce a single R-F signal varying in frequency. These components and the frequency-modulated R-F output are shown in figure 1-8. Note that the frequency-modulated carrier passes through the center frequency (f_c) twice for each cycle of the modulating signal and that its amplitude is constant. Increasing the frequency of the audio modulating signal, figure 1-8, will increase proportionately the number of times per second that the modulated radio frequency passes through the center frequency, and vice-versa. The effect of decreasing or increasing the amplitude of the modulating signal is to decrease or increase the frequency deviation without affecting the number of frequency excursions per second.

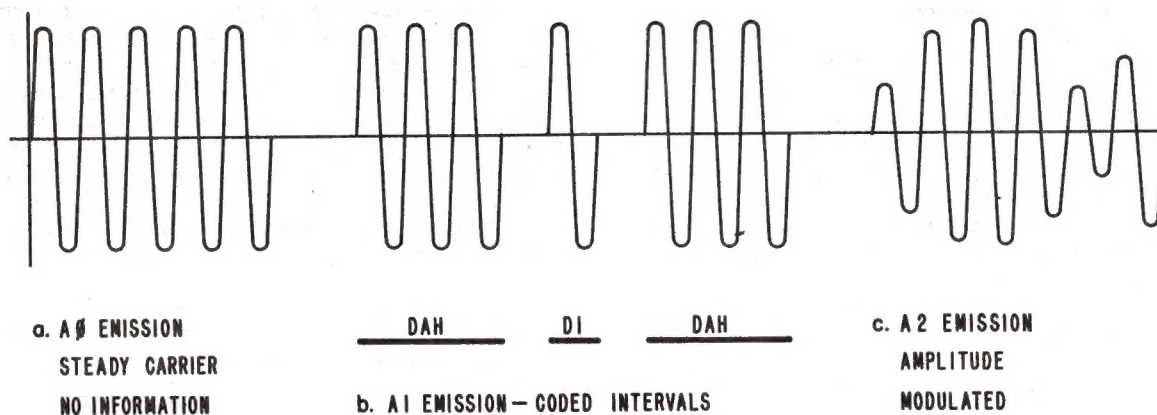


FIGURE 1-1 RF WAVEFORMS

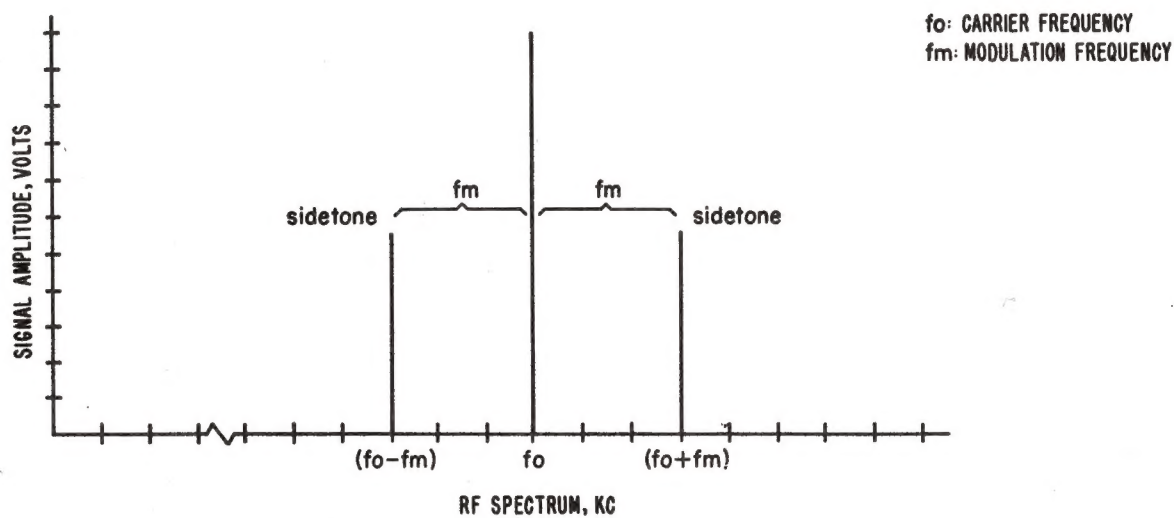
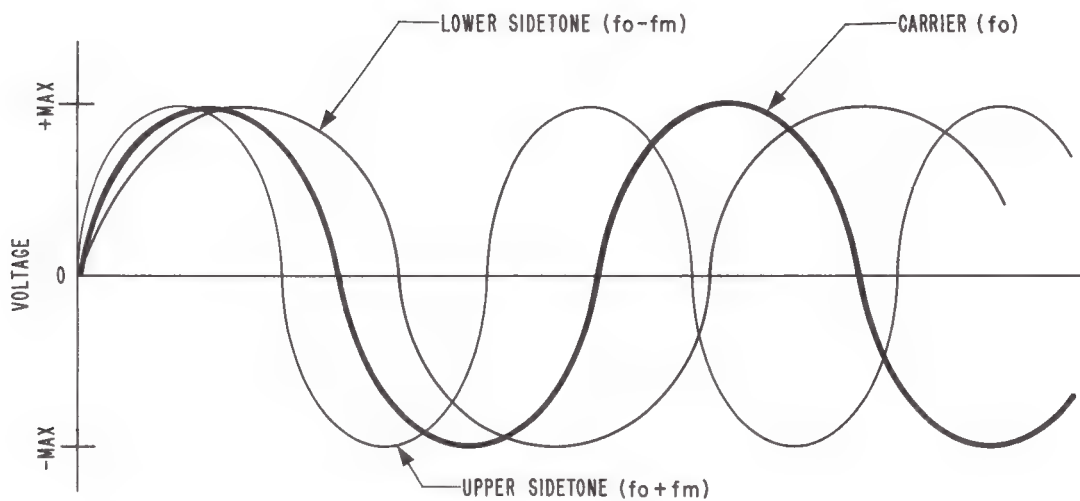


FIGURE 1-2 FREQUENCY DISTRIBUTION, SINGLE-TONE MODULATION

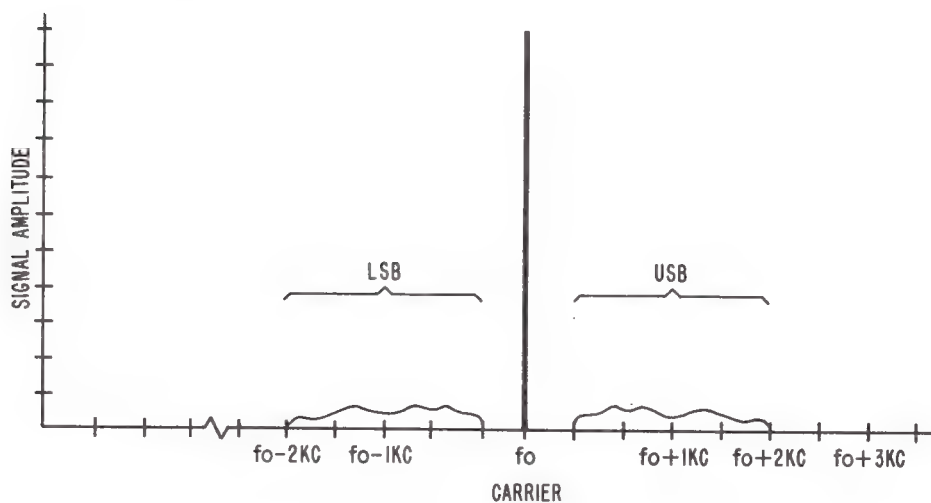


a. RF COMPONENTS OF SINGLE-TONE AM SIGNAL (SUCH AS A2 EMISSION)



b. AF BEAT FREQUENCY BETWEEN CARRIER AND EITHER SIDETONE (a., ABOVE)

FIGURE 1-3 RF COMPONENTS AND BEAT FREQUENCY, SINGLE-TONE MODULATION

FIGURE 1-4 FREQUENCY DISTRIBUTION, CARRIER AND TWO SIDEBANDS
CPS MODULATION 100-2000

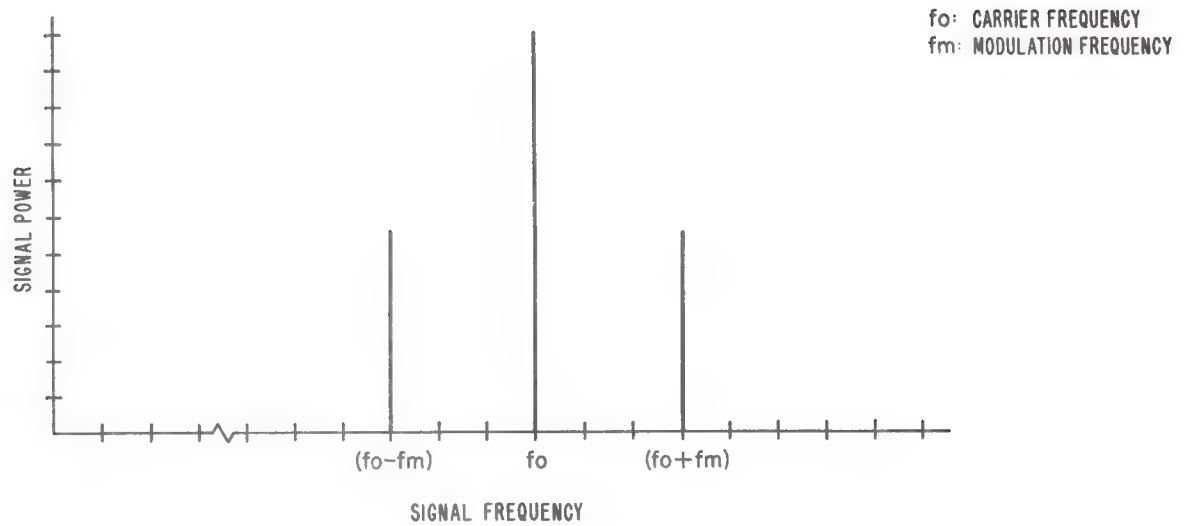
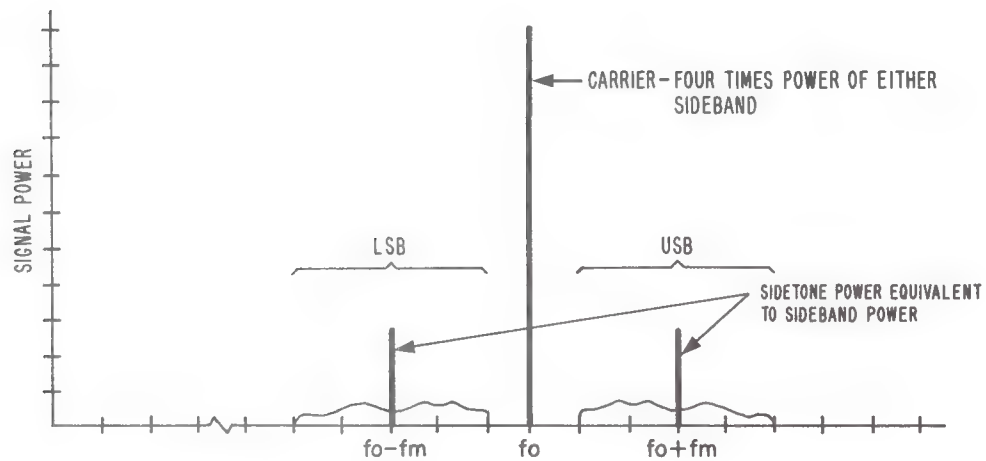


FIGURE 1-5 POWER DISTRIBUTION IN 100%, SINGLE-TONE MODULATED SIGNAL

FIGURE 1-6 POWER DISTRIBUTION IN RF SIGNAL
100% MODULATED BY 100-2000 CPS AF

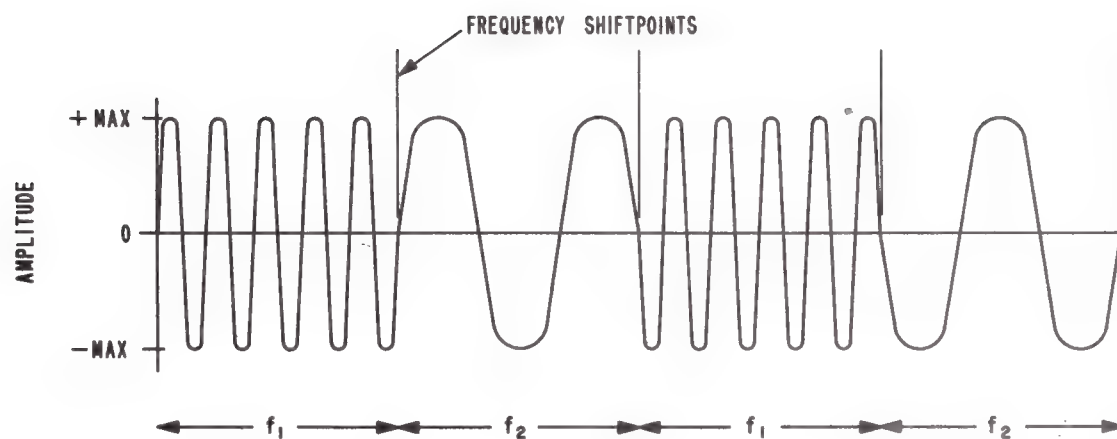


FIGURE 1-7 FI WAVEFORM (FREQUENCY-SHIFT KEYED)

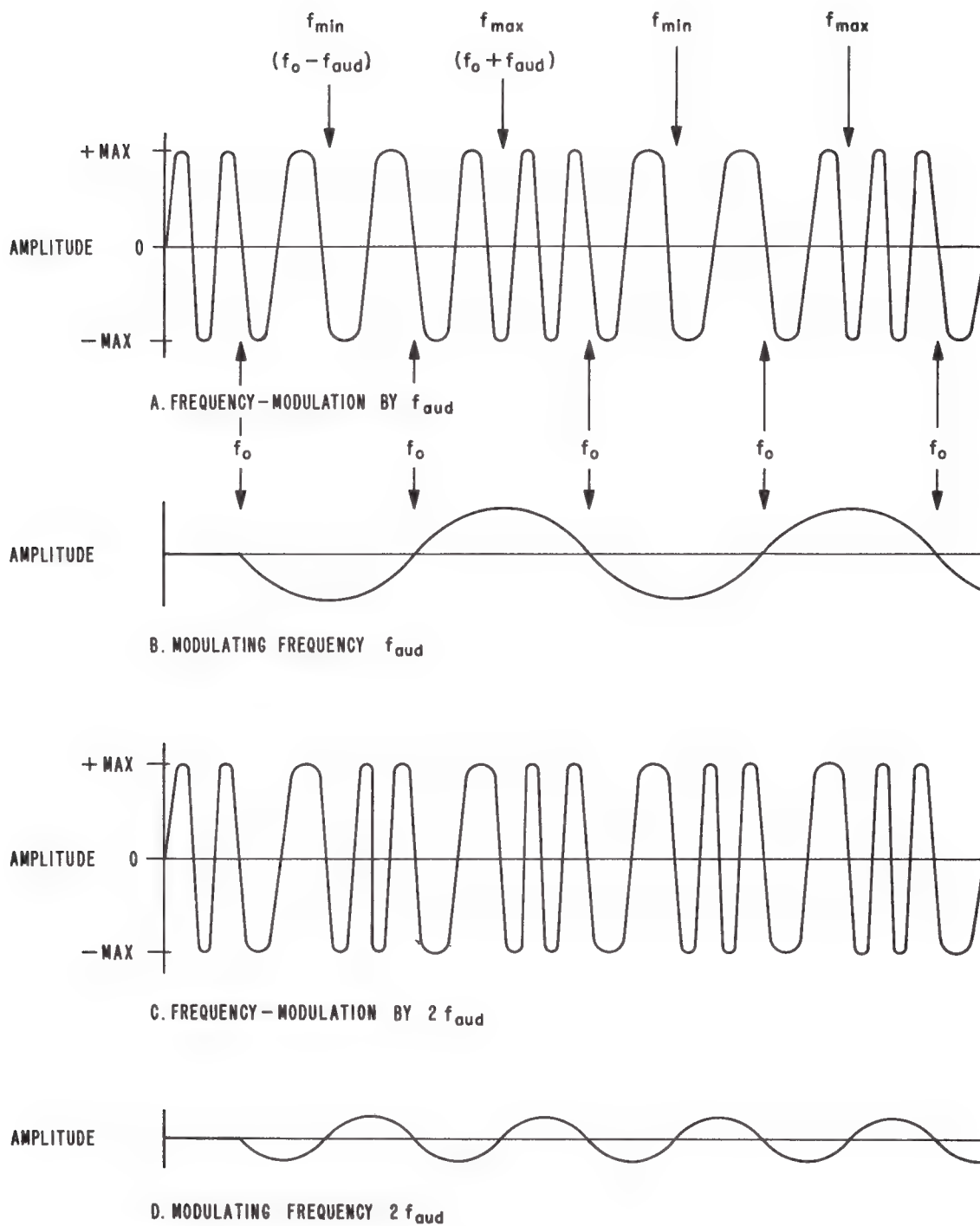


FIGURE 1-8 F2 WAVEFORM (FREQUENCY-MODULATED BY A SINGLE AUDIO FREQUENCY)

1-2 CHECKING COMMUNICATION SYSTEMS

GENERAL CONSIDERATIONS. It has been demonstrated repeatedly that uhf communication is satisfactory. However, all the parts of the system must operate normally in order to avoid communication failures. Thus it is desirable to have at hand some means of checking the parts of the system and the over-all performance.

A simple check with a nearby ship and a report of "I hear you loud and clear" indicates little more than that the equipment is turned on, patched to the right outlets, and on the same channel. It does not indicate whether a slightly greater range is obtainable. However, this indication can be obtained from the equipment with some additional work.

It is still true that adequate range is obtainable only by reducing the losses (expressed in decibels) over the complete circuit to a satisfactory low level. Assuming some signal-to-noise ratio at the headphones is necessary for satisfactory reception, it is possible to figure the transmitter power necessary if the receiver sensitivity, cable loss, receiving antenna gain, attenuation in space, transmitting antenna gain, and transmitter cable loss are known. It follows that for a known distance between stations, it should be possible to use the input meter of a Receiving Set, Radio AN/URR-35 or Radio Receiving Set AN/URR-13 to determine whether there are any unacceptable losses in the system. This over-all check is described in greater detail following some methods of checking parts of the system.

The methods described are not intended to replace the maintenance checks prescribed for equipments in applicable POMSEE publications, but are to be used with the maintenance checks to provide an over-all systems check.

RECEIVER SENSITIVITY. The receiver sensitivity should be measured. It should be possible to obtain a 10-db signal-to-noise ratio with less than 10 microvolts input from a signal generator, such as RF Signal Generator Set AN/URM-26. This subject is described in the instruction book and maintenance standards book for the particular receiver under test.

The sensitivity of the receivers may be measured also through associated cables and connectors (including the transmitter antenna relay if the same antenna is used for transmitting and receiving) in order to aid in locating trouble in associated local cables and connectors.

TRANSMISSION LINE TESTS. With a suitable fitting for a megohmmeter (Radio Frequency Jack UG-21/U and Radio

Frequency Adapter UG-29/U) the antenna cables can be checked. A resistance reading well below one megohm suggests a short circuit developing in the cable; a reading of several hundred megohms suggests that the inner conductor may be open. A more complete check of open circuits is given by shorting the insulated half of the antenna dipole to ground, but the protective paint makes this method unsatisfactory as a routine measure. Removing the antenna connector and shorting the inner conductor of the cable to the copper braid gives a useful check, but in one case this did not disclose an open circuit within the antenna itself.

It is desirable to ascertain the cable loss between the receiver and the antenna. This can be determined by disconnecting the cables from two antennas and joining the cables with a Radio Frequency Adapter UG-29/U connector in order to form a loop. Connect the signal generator to the receiver and adjust the attenuator to give a convenient reading, such as 0.25 ma, on the receiver's input meter. Then connect the receiver and signal generator to the two ends of the loop of cable and readjust for the same input meter reading. The difference between the two readings of the attenuator gives the total cable loss, roughly half of which is in each cable. This may be checked further by measuring other connectors on the mast to determine the exact loss in each cable. The loss in an average length of Radio Frequency Cable RG-18/U may be as low as 6 decibels, but losses as great as 18 decibels have been found in long runs of smaller cable such as Radio Frequency Cable RG-10/U. Input and output readings on any multicouplers may be obtained at this time.

The previous check gives a positive measure of cable loss but requires making connections on the mast. A routine over-all check can be made from the receiver location with much less work. This is done by connecting the signal generator to one antenna cable and picking up the signal in a receiver connected to another antenna. With close spacing of antennas (about 6 feet) and moderate runs of Radio Frequency Cable RG-18/U, the round trip loss will be about 30 db. With an antenna spacing of about 60 feet, the loss will be around 50 db (20 db more for a 10-to-1 increase in antenna spacing). Either figure will be greater with longer cable runs or smaller cable. This type of check can be made regularly in a few minutes, giving an early indication of cable or antenna trouble. It is superior to using a "megger" because it shows trouble that does not give normal megohmmeter readings. The following two sets of measurements of signal generator output in decibels, required to give the same input meter reading at Fifth Naval District headquarters, illustrate the point.

	21 January			23 February	
	Attenuator	loss	Attenuator	loss	change
SIGGEN direct	-56.0		-68.2		
Antenna #1 to #2 (about 40 feet)	-9.3	46.7	-15.9	46.6	-0.1
Antenna #1 to #3 (about 40 feet)	-9.2	46.8	-5.7	62.5	15.7
Antenna #2 to #3 (about 4 feet)	-27.6	28.4	-17.7	44.8	16.4

ORIGINAL

It is clear from these figures that antenna No. 3 developed an increased loss of about 16 db, although it continued to check satisfactory (300 megohms) on a "megger." This procedure is very helpful when the figures have been recorded from time to time and when the magnitude of the round trip loss has been determined to be satisfactory.

TRANSMITTER TUNING AND POWER CHECK. Most transmitter tuning should be done with RF Wattmeter ME-11/U substituted for the antenna. This not only eliminates interference with other ships, but enables proper tuning to assure loading for maximum power output under conditions of radio silence. The antenna circuit may be retuned for maximum deflection on the transmitter tuning meter after the antenna has again been connected to the transmitter, since some standing wave conditions on the transmission line may make such retuning necessary. When in port, the wattmeter may be moved to the antenna end of the transmitter cable to check cable loss if the performance of the system warrants it.

The wattmeter also may be connected to an adjacent antenna to ascertain that the antenna itself is radiating power effectively. If the wattmeter is connected at the transmitter end of the cable leading to an adjacent antenna, the reading is likely to be less than one watt which is not adequate for a satisfactory system check but does give some confidence in the performance of the R-F cables and the antennas. However, if a receiver is available near the transmitter, the receiving antenna checking procedure described previously can be used to measure the round trip loss in two antennas and their cables.

SYSTEM TESTING. For routine checking of the uhf system, it is more convenient to test both the transmitting and receiving portions of the system at the same time. This may be done by using uhf transmitter on its normal antenna, observing the input meter of a uhf receiver connected to a separate antenna, preferably one on a different yardarm. Inasmuch as the signal varies as $1/d$ (inverse distance) within the horizon (changing to $1/d^2$ beyond), there is a direct relationship between the receiver input meter and the distance range on the surface that can be expected of the equipment. For ships with high antenna, the following should be experienced:

Each installation will have to be checked when in good condition for the standards to be expected during routine

testing or operating conditions. It is obvious that, except for meter readings above about 0.85 ma which are less accurate, observation of the RECEIVER input meter tells much more about the operation of uhf equipment than does the fact that "strength five" signals were received at all the distance listed in chart. The system described in the previous paragraph is applicable to equipment on the same ship, nested ships, or widely spaced ships. Therefore, it provides a useful tool to confirm satisfactory operation of uhf equipment and to assist in locating faulty equipment or installations. It provides a means of checking each channel of each transmitter against each receiver, to provide assurance that there are no inoperative channels. It does not, however, directly check the antenna radiation at all bearings, though this may be done also by swinging ship and observing the input meter variations.

In a normally sensitive receiver, the input meter changes close to 0.1 ma between 0.1 and 0.5 on the scale, for each 6-db change in receiver input.

For those ships having Monifor, Radio Frequency AN/URM-50, rough operational standards may be determined when setting up the frequency plan. Each transmitter frequency should be monitored and a graph or chart made to indicate relative power output at each frequency. This does not check the receiving portion of the system, however, and in many instances the antenna on the radio frequency monitor is not well located; if it is available, it should be used whenever possible.

In addition, there is the multicoupler problem that may be minimized by an extension of the tests and principles applied herein. Many cases of extreme losses have been noted by means of wattmeter tests, but tuning for maximum output is often a problem, especially when several frequencies close together are set up on the same multicoupler combination.

As in any system, it must be noted that often unrelated parts of the system can influence the operational capabilities of the plant. Therefore, quick and meaningful tests must be available to the technician, and preferably the operator, so any question as to system reliability may be readily resolved.

Input Meter (ma)	Distance between Antennas	Db below 0.1 volt
0.87	6 feet	9.0
0.82	60 feet	
0.74	600 feet	29.0
0.60	1 mile	49.0
0.36	10 miles	69.0
0.05	20 miles	95.0

1-3 POWER SUPPLIES

GENERAL

Power supplies which are part of TRANSMITTING EQUIPMENT, paragraph 1-6, or RECEIVERS, paragraph 1-7, can be placed in a category with one of the types described in this section. Since troubleshooting procedures are the same for part of the self-contained equipment as for the unit-type power supplies, regardless of voltage and current requirements, the description is not repeated in paragraphs 1-6 and 1-7.

SCOPE

Power supplies commonly used in electronic equipment are of the following types:

- a. Unregulated supplies, usually providing filtered but unregulated low B-plus (under 300V DC) or high B-plus (over 300V DC), in addition to a-c heater power for vacuum tubes and in some cases relay-operating power.
- b. Regulated power supplies, consisting of an un-

regulated supply and associated circuitry to regulate the B-plus output.

- c. Motor-generator sets to supply the above voltages.

Troubleshooting malfunctioning power supplies should be preceded by a preliminary checkout procedure covering the simple, easily overlooked causes of trouble. This preliminary troubleshooting procedure is followed by the procedures for the basic unregulated power supply and the regulating circuitry. Motor-generator sets, on the other hand, require continual routine maintenance of a mechanical rather than electrical nature, but little troubleshooting. Both maintenance and troubleshooting procedures for motor generators are given in chapter 60 of the Buships manual.

PRELIMINARY POWER SUPPLY TROUBLESHOOTING PROCEDURE

The following quick checkout procedure can be performed without removing the equipment from its cabinet or console. Some steps result in correction of the malfunction, while others determine on what following step to proceed.

Step	Condition	Check	If	Action
a.	No power and no panel lights	Line cord	Not plugged in	Plug in
		Fuse	Defective Good Blown Blows again Incorrect	Replace Start with step b. Check dial settings and replace fuse Start with step a. below Set correctly
b.	Input power present, but some voltage indications at supplied equipment not normal	Switch and dial settings	Unplugged	Plug in
		Cables	Plugged in	Start with step b. following

POWER SUPPLY TROUBLESHOOTING PROCEDURE

Perform the appropriate following steps in troubleshooting unregulated supplies or the unregulated portion of regulated supplies.

Step	Condition	Check	If	Action
a.	Fuse blows repeatedly	Remove load, replace fuse, and energize again	Operation is normal	Troubleshoot supplied equipment (load) for: 1. Tube shorts 2. Wiring shorts 3. Overheated components
			Fuse blows again	Check power supply: 1. Tubes 2. Electrolytic capacitors for leakage 3. Other capacitors for leakage 4. Compare power transformer winding resistances with normal values and replace transformer if defective
b.	Not all output voltages present at supplied equipment	Use voltmeter to determine where voltages are lost between transformer and supplied equipment	Open circuit is found One (or more) transformer outputs are missing	Make necessary repair or replacement Use ohmmeter to verify that transformer winding is shorted or open; replace transformer

Step	Condition	Check	If	Action
c.	Some or all output voltages are not correct	Transformer primary tap connections for various line voltages	Incorrect connection for input voltage being used	Change to correct connections
		Transformer winding voltages and resistances	Any winding is open or has shorted turns (indicated by changed resistance)	Replace transformer
d.	Incorrect d-c output (following performance of steps b. and c.)	Tube condition	Tube (s) defective or has low emission	Replace Tube (s)
		Electrolytic capacitors	Defective	Replace capacitors
e.	Output voltage level varies	Intermittent conditions by metering output	Tapping component or terminal affects voltage	Inspect component or connection tapped and replace or repair if defective

REGULATED POWER SUPPLY TROUBLESHOOTING PROCEDURE

a. If any symptoms of the regulated power supply resemble those for the unregulated type of supply, troubleshoot them by using the appropriate steps given for the unregulated supplies. If necessary, disconnect the regulating circuitry for troubleshooting and repair in these steps.

b. Verify that the unregulated output are of the correct voltage. The a-c voltages (5.0V AC and 6.3V AC) are usually unregulated and can be measured at the unit's output. The unregulated d.c. can be measured at the input to the series-pass tubes or at the regulator output, with the shunt-regulator tubes removed.

c. Determine the effectiveness of regulation circuitry by adding a resistive load that is ten times the resistance of the real load. Use resistors of power capabilities no less than that calculated from the resistance and the voltage. Connect this load in parallel with the normal B-plus load and insert a switch in the normal load. Meter the output voltage while switching the normal load on and off. The regulating circuitry is defective if the voltage drop under full load exceeds the power supply specifications. If this is the case, perform step d.

d. If the regulation is defective, use Tube Tester TV-3A/U or equivalent to determine the condition of all tubes in the regulating circuitry. Be sure to determine the

condition of any voltage regulating tubes included. Return each acceptable tube to its original socket and replace defective tubes.

e. Make any adjustments given in the technical manual for regulation of the output voltage. Follow the directions given in the technical manual to set up the conditions specified for making these adjustments.

f. Make tube socket voltage and resistance measurements in the regulator circuitry, following the directions given in the technical manual for setting up the required load conditions. Replace any defective components that could cause incorrect values.

g. If acceptable regulation with load connected cannot be obtained due to excessive current drain, determine where in the load circuitry the excessive drain is occurring. This can be done by removing tubes in the supplied equipment one by one, noting how much the current requirement is reduced for each tube withdrawn. When the withdrawal of a particular tube reduces the current by an amount greater than the tube requirements (plate and screen), both the tube and its associated circuitry should be investigated. Typical reasons for excessive current are defective screen bypass capacitors, leaky decoupling capacitors, and defective (shorted or gassy) tubes. Correct the conditions causing the excessive load.

1-4 TELETYPE EQUIPMENT

GENERAL

Teletype equipment is used extensively for transmission of messages where personal contact is not needed and where a written record is desired. Teletype equipment takes the following forms:

- Pageprinter receiver
- Keyboard transmitter
- Keyboard tape perforator
- Reperforator
- Tape transmitter.

Various combinations of these equipments are used, both as sets and combined in individual equipments. The best known of these are the keyboard pageprinter for both receiving and transmitting and the keyboard transmitter-reperforator.

Teletype equipment is common use in the services is operated, for the most part, at a nominal 60-wpm rate, using a standard 7.42-unit start-stop transmission pattern as shown in figure 1-9. This pattern consists of a 22-millisecond start interval (SPACE), five 22-millisecond character code intervals (SPACES AND MARKS), and a 31-millisecond stop interval (MARK).

Several teletype equipments can be patched together in the same local series circuit, or loop, to carry the same signal. Such a loop is connected to the desired line or terminal equipment by means of a line relay, which is described in paragraph 1-8, TERMINAL EQUIPMENT, for either transmission or reception.

SCOPE

This section gives troubleshooting procedures which include the most commonly needed electromechanical adjustments on the teletype equipments listed in paragraph 1-4. These adjustments are given as responses to specific malfunctions, rather than related to malfunctions in specific equipments. None of the adjustments given are electronic in nature but are those most frequently needed in troubleshooting to obtain acceptable synchronization and message reproduction. Most other adjustments on teletype equipment are mechanical and will be found in the appropriate technical manuals. Adjustments of associated terminal equipment - relays, keyers, comparators, and converters - are given under paragraph 1-8, TERMINAL EQUIPMENT.

TROUBLESHOOTING PROCEDURE FOR INOPERATIVE TELETYPE EQUIPMENT

Use the following steps if the equipment is apparently without power; if the motor and maintenance lamp cannot be energized.

- a. Insert the power plug into the socket correctly. Replace the power plug and/or cord if defective.
- b. Replace power distribution fuse(s) if blown.
- c. If machine blows fuses repeatedly, inspect the equipment for short circuits (often indicated by visual damage, heating, or smoke), restriction of mechanical action, or tight motor bearings. Appropriate corrective measures are cleaning, lubrication, adjustment, and replacement of parts.

- d. Follow further procedures in the technical manual if the equipment is still inoperative.

TROUBLESHOOTING PROCEDURE FOR TELETYPE MOTOR HAVING IRREGULAR SPEED

Use the following steps if the teletype motor speed is irregular or will not continue to run at the correct speed following adjustment.

- a. Meter the line voltage to verify that is constant. Line voltage instability can be due to a varying load. If the cause of voltage instability cannot be found locally and corrected, report the condition to power engineering personnel.
- b. Inspect the motor for defective bearings; lubricate or replace them if required.
- c. Inspect the motor brushes IF THE MOTOR IS GOVERNED TYPE (for a-c and d-c operation); replace the brushes and clean the motor if required.
- d. Follow the further procedures in the technical manual if speed instability persists.

TROUBLESHOOTING PROCEDURES FOR TELETYPE RECEIVERS

Use the following steps if the teletype receiver does not operate, although its motor is running and it is plugged into a local receiving loop.

- a. Verify by visual inspection that the motor, main shaft, and drive gears are turning correctly. If they are not, follow the appropriate procedures given in paragraph 1-4 and in the technical manual.
- b. Verify that the receiving (red shell) plug is inserted properly and that both plug and cord are in good condition; repair or replace either if defective.
- c. Measure the loop current with the suspected defective machine plugged in and then with a known operative machine plugged in its place. If no loop current is measured with either machine plugged in, check the loop current supply and all loop terminals and connections. Also test the suspected defective machine on a known operative line to determine its condition.
- d. Attempt to adjust the rangefinder (orientation adjustment) as described in **Troubleshooting Procedure for Teletypewriters Printing Garbled Messages**, returning it to its original setting if acceptable operation is not obtained. Test the coil of the selector magnet (mounted on the same bracket as the range finder assembly) for continuity and replace if defective.
- e. If the equipment still does not receive, follow the troubleshooting procedures given in the technical manual.

TROUBLESHOOTING PROCEDURE FOR TELETYPE TRANSMITTERS

Use the following steps to troubleshoot a teletype transmitter which is unable to transmit, although its motor is operating and it is plugged into a local sending loop.

- a. Verify that the motor, shaft, and gears are turning correctly. If they are not, follow the procedures given in **Troubleshooting Procedures for Inoperative Teletype Equipment and Teletype Motor Having Irregular Speed**, and in the technical manual.

b. Verify that the transmitting (black shell) plug is inserted properly. Examine both plug and cord and repair or replace either found to be defective.

c. Measure the loop current with the suspected defective machine plugged in and then with a known operative machine plugged in and operated in its place. If no loop current is found in either case, check the loop current supply, continuity through any other equipments, and all loop terminals and connections. Also test the suspected defective machine on a known operative line.

d. If loop current through the defective machine is constant at either a MARK or SPACE level, observe the transmitting cam sleeve rotation when a single character is transmitted. If the cam does not turn, check all linkages, mechanical operations, and clutch mechanisms associated with transmission. If the cam does revolve correctly, inspect all contacts used for signal transmission, including the contacts joining the equipment base to the transmitter. Clean, adjust, and burnish contacts if necessary.

e. If operation is not restored by the previous steps, follow the troubleshooting procedures given in the technical manual.

TROUBLESHOOTING PROCEDURE FOR TELETYPE-WRITERS PRINTING GARBLED MESSAGES

Use the following steps to troubleshoot for and correct the cause of garbled reception.

In performing these steps, a known, undistorted signal will be useful. Such a signal is supplied by many teletype test sets:

Teletype Distortion Analyzer/Checker TS-658/UG is suggested for this and other applications. Any other equipment having the required capabilities can be substituted.

a. If the incoming message is reproduced in garbled form by the pageprinter or tape reperforator, first adjust the rangefinder (orientation adjustment). Do this by loosening the knurled nut, moving the lever until clear copy is received, noting the highest setting and the lowest setting at which clear copy is still received, and tightening the nut with the lever halfway between the positions noted. If no input is obtained, leave the lever at its original setting.

b. If a message transmitted by radio is garbled, verify that the receiver is tuned correctly and that the MARK and SPACE pulses are received at the same amplitude. Correct tuning is indicated for each channel by its channel converter, more fully described in the technical manual for converter-comparator equipments. Satisfactory tuning is indicated on converters having monitor oscilloscopes by the two heavy horizontal trace lines falling on the upper and lower graticule lines, as shown in figure 5-10. In tuning, the receiver is first tuned for a maximum indication at its input meter and the BFO (Beat Frequency Oscillator) then adjusted above the incoming signal to center the tuning pattern on the oscilloscope face. Then the receiver GAIN is adjusted so that the pattern lines fall on the two outer graticule lines. If tuning appears to be correct but the message is still garbled, check the BFO setting by operating the MARK-SPACE switch to the REVERSE position. If this restores operation, return it to the NORMAL position

and tune the BFO through zero-beat until the monitor oscilloscope again indicates the correct tuning pattern.

c. If garbling persists in a teletype machine using an ac-dc brush-and-commutator motor, determine the motor speed and adjust if necessary. First determine the approximate speed of a keyboard machine by holding down both the repeat key and any character key for 10 seconds. A machine set for 60-wpm operation will type or punch 60 characters in this interval. Make a preliminary speed adjustment, if needed, then determine the speed more precisely by tuning on the light above the motor flywheel, lightly tapping the tuning forkspeed indicator, and looking at the flywheel through the vanes at the vibrating end of the tuning fork. The motor speed is then adjusted so that the white segments on the flywheel appear to stand still. The speed is considered acceptable if no more than 12 white segments pass an observed point in 10 seconds. On some equipments, this adjustment is made with the motor running by pressing against the governor adjusting bracket or the governor adjusting lever. Some newer equipments are adjusted by stopping the motor and adjusting a screw through an access hole in the side of the flywheel, clockwise for higher speed. The motor must be stopped for alternate adjustments and speed determinations to obtain the correct speed setting for these newer models.

d. Teletype equipments using synchronous motors do not provide for speed measurement and adjustment. If all such equipments are offspeed, the line frequency should be determined and power-generating personnel informed of any frequency deviation. If only one such equipment is off frequency, its motor and drive shaft should be inspected for points needing lubrication and for any mechanical binding.

e. If message reproduction is still garbled, plug a similar known operative machine on the same loop as the suspected defective machine. Then plug the suspected defective machine in on a correctly functioning loop. Observation of the results will permit appraisal of both the condition of the suspected defective machine and the quality of the incoming signal. The condition of the machine can be tested also by use of a no-distortion, no-bias signal input from the distortion analyzer test set. If either test indicates that the incoming signal is defective, the distortion analyzer can be used to determine the type and extent of distortion or bias. Except in units including line relays, no adjustments for these conditions are located within teletype receiving equipments.

f. If received messages are still garbled, follow the further troubleshooting procedures given in the technical manual.

TROUBLESHOOTING PROCEDURE FOR TELETYPE-WRITERS TRANSMITTING GARBLED MESSAGES

Use the following steps to troubleshoot for and correct the cause of garbled transmission:

a. Verify that the teletype equipment is actually transmitting garbled messages by plugging a pageprinter set to the same word rate (usually a nominal 60 wpm) into the loop while the transmitter is being operated. If operation is acceptable, check the loop current and operation of associated terminal equipment.

b. If transmitter malfunction is indicated in step a. check the motor speed, using **Troubleshooting Procedure for Teletypewriters Printing Garbled Messages**, steps c. and d. Verify that both transmitting and receiving equipment are set to the same word rate; if not, set both to the desired rate.

c. Inspect the transmitter for contact condition (clean and burnish if required), contact adjustment (adjust, using the procedures given in the technical manual), lubrication, and mechanical action (adjusting and replacing components if required).

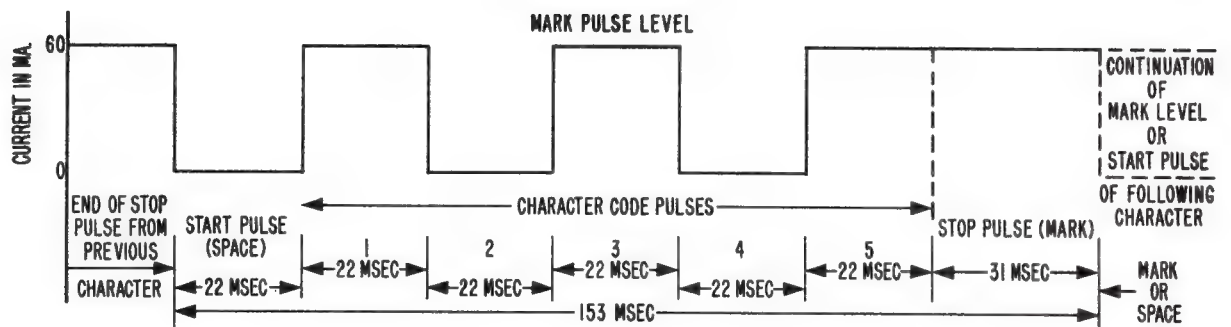


FIGURE 1-9 FORMATION OF LETTER "Y" IN FIVE-UNIT, START-STOP TELETYPE CODE

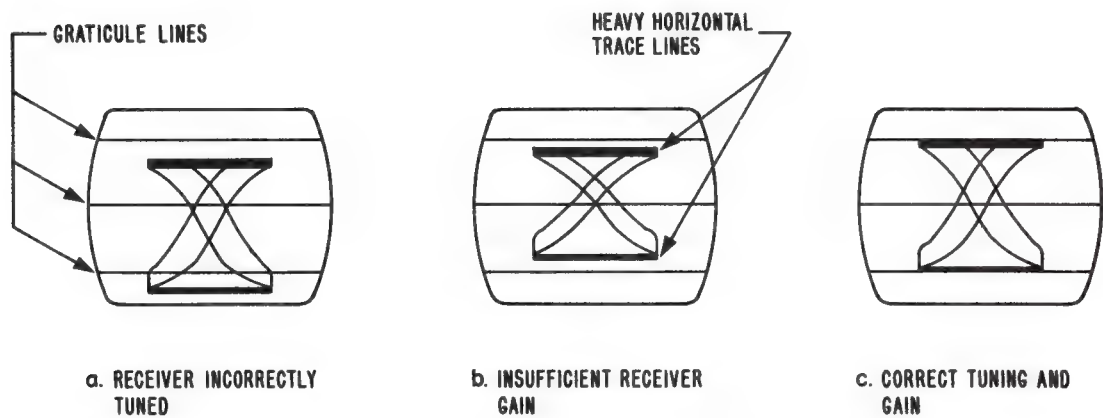


FIGURE 1-10 TUNING PATTERNS ON TELETYPE MONITOR OSCILLOSCOPE

1-5 REMOTE CONTROL UNITS

GENERAL

Remote control units are used to control transmitters and receivers from remote phone or telegraph stations. The transmitter and receiver are tuned at the equipment location and only POWER (transmitter B-plus power), CARRIER ON (carrier transmission), and receiver mating switching are controlled from the remote units.

The troubleshooting procedures following are intended for use with the most commonly used Controls, Radio Set C-1138/UR and C-1207/UR, and consequently refer to voltages and terminals found in these equipments. This has been done to enable them to be as useful as possible; the procedures can be applied to other similar equipments if the correct voltages and terminal designations are used.

PRELIMINARY MALFUNCTION VERIFICATION

Since this equipment is used by many persons, the electronics technician maintaining it may wish to verify the symptoms of units reported malfunctioning. The following quick-check procedure can be used for this purpose. It requires the presence of a man at the remote unit and another at the controlled equipment, with telephonic communication between them or use of a prearranged sequence and timing of test steps. The transmitter need not be on the air but should be energized to an extent enabling it to indicate when it is keyed or modulation is applied.

Step	Operation at Remote Unit	Correct Indication at Remote Unit	Correct Indication at Controlled Unit
a.	Depress START switch for 3 seconds	POWER indicator energized	POWER indicator energized (B-plus applied to transmitter)
b.	Depress handset push-to-talk switch (for phone operation)	CARRIER ON indicator energized and associated loudspeaker amplifier muted	CARRIER ON indicator energized and carrier transmitted in normal operation
c.	Operate telegraph key (for CW operation)	Receiver output muted during key-down intervals	Transmitter keyed and carrier transmitted in normal operation
d.	Talk into handset transmitter with push-to-talk switch still depressed	Loudspeaker amplifier muted as in step b.	Modulation during normal operation
e.	Release push-to-talk switch	CARRIER ON indicator deenergized and associated amplifier demuted	CARRIER ON indicator deenergized and transmission stopped during normal operation

Step	Operation at Remote Unit	Correct Indication at Remote Unit	Correct Indication at Controlled Unit
f.	Depress STOP switch	POWER indicator deenergized	POWER indicator deenergized (B-plus removed from transmitter)

INDICATOR AND CONTROL TROUBLESHOOTING

Use the appropriate steps among the following for malfunction in the indicator and transmitter control circuits until proper operation is restored or the malfunction identified.

Step	Indication	Action
a.	POWER indicator and/or transmitter cannot be energized	Replace bulb if burnt out. Determine condition of START switch. Measure 115/230V AC input to remote unit at terminals 2 and 4 of TB101 or E102. Make sure that POWER indicator series resistor is not jumpered for 230-volt operation.
b.	No 115/230 V AC power input present	Test for presence of power at transmitter. Test for power at switchboard (if any). Test wiring and connections for continuity
c.	POWER indicator energized only while START button depressed	Check transmitter power relay for coil continuity and contact condition
d.	POWER indicator and/or transmitter not deenergized when STOP button depressed	Determine condition of STOP switch. Check continuity of STOP switch wiring to transmitter. Determine condition of power relay coilshunting resistor. Check adjustment and condition of power relay; clean and adjust if necessary
e.	CARRIER ON indicator cannot be energized	Replace bulb if burned out. Measure voltage at terminals 7 and 8 of TB 101 or E102 (should be 12V DC)
f.	12V DC not present at remote control unit	Check for presence of 12V DC at transmitter. Check for presence of 12V DC at switchboard. Check wiring and connections for continuity
g.	CARRIER ON indicator not energized by 12V DC present at remote control unit	Check contacts and action of handset push-to-talk switch. Check remote unit relay coil continuity, action, and contact condition

Step	Indication	Action
b.	CARRIER ON indicator and/or transmitter R-F output not deenergized when handset push-to-talk switch released	Check adjustment of handset push-to-talk and holder switches. Clean and adjust armature gap and contacts of CARRIER ON muting relay

HANDSET TRANSMITTER (MICROPHONE) TROUBLESHOOTING

Use the appropriate steps among the following for malfunctions in the handset transmitter circuits, until proper operation is restored or the malfunction identified.

Step	Indication	Action
a.	No handset transmitter output at terminals 9 and 10 of TB101 or E102 (should be approximately 4V RMS when push-to-talk button depressed and microphone spoken into)	Check terminals 2 and 4 of TB101 or E102 for presence of 12V DC. If not present, check source of 12V DC (in transmitter) and continuity of connecting wiring and terminals
b.	No handset transmitter output, but microphone supply voltage present	Measure d-c voltage across across audio transformer primary and across microphone with equipment energized, POWER ON, handset removed from holder, and push-to-talk switch operated. Each of these voltages should be between 4 and 8V DC and their sum equal to the input voltage.
c.	12V DC measured across audio transformer primary during operation in step b.	Replace the transformer if use of an ohmmeter verifies that the transformer winding is open
d.	12V DC measured across microphone during operation in step b.	Test all connections and switch contacts in operating position for continuity to microphone. Clean and adjust if required. Replace microphone if its d-c resistance (as measured by an ohmmeter) exceeds 60 ohms or is less than 20 ohms

HANDSET RECEIVER (EARPHONE) TROUBLESHOOTING

Use the appropriate steps among the following for malfunctions of the handset receiver circuits, until proper operation is restored or the malfunction identified.

Step	Indication	Action
a.	Handset receiver inoperative	Verify that the earphone level attenuator is at its maximum clockwise rotation and the radio receiver is operating. Measure the a-c (audio frequency) voltage at terminals 13 and 14 of TB102 or 103. Measurements of up to 15V RMS are normal, depending on the radio receiver audio gain setting.
b.	No A-F input to remote unit	With radio receiver still operating, disconnect the input leads to terminals 13 and 14 of TB102 or 103 and again measure the signal across these leads. If there is still no input, check the radio receiver for output at the desired level, A-F connections and switching, and continuity of the audio distribution wiring to the remote unit
c.	Handset receiver inoperative, but A-F input is present at remote unit	Determine condition of earphone level control and replace if defective. CARRIER ON muting relay should not be energized; if it is, inspect handset holder switch for contact condition and adjustment, cleaning and adjusting if necessary. Verify that radio receiver output is present at terminals A and B of handset holder switch
d.	A-F signal is present at terminals A and B of handset holder switch in either position, but no receiver audio output heard	If the handset holder switch has been inspected for correct switching action, check the handset receiver and wiring for open circuits; replace the receiver if defective
e.	Radio receiver output measured at terminals A and B of handset holder switch only when handset is in holder or handset receiver disconnected	Check the handset receiver and wiring for a short circuit and replace the receiver if it is found defective

TROUBLESHOOTING THE OUTPUT TO LOUDSPEAKER AMPLIFIER.

Use the appropriate steps among the following if the remote control unit output to an external amplifier appears to be malfunctioning.

Step	Indication	Action
a.	Apparently no A-F output from the external loudspeaker amplifier driven by the remote control unit	Leave handset in holder after verifying, as in paragraph 5-5, HANDSET RECEIVER (EARPHONE) TROUBLESHOOTING , that the proper earphone input is present. Measure the a-c voltage between terminals 13 and 14 and terminals 19 and 20, TB102 or E103. If the voltages measured are approximately the same, measure the voltage across the corresponding input terminals of the loudspeaker amplifier. If essentially the same value is measured there, the remote unit is not causing the malfunction; continue troubleshooting the amplifier
b.	A-F signal found at output of remote unit but not at input to associated loudspeaker amplifier	Inspect the connections and wiring between the amplifier and the remote control unit for continuity and absence of short circuits
c.	A-F output can be measured at terminals 19 and 20 of TB102 or E103 only when leads to associated amplifier are disconnected	Measure the signal at the amplifier end of the interconnecting wiring with the other connected to the remote unit and receiving a signal. If the signal is absent, check the line for an open circuit. If the signal is present at the amplifier end, troubleshoot the amplifier input circuitry
d.	A-F voltage across terminals 13 and 14 is not the same as that across terminals 19 and 20, TB102 or E103, when handset is in holder	Inspect the CARRIER ON muting relay to make sure that it is not energized. Adjust the handset holder switch contacts if the relay is energized. Adjust the relay contacts of the relay is unenergized; normally closed contacts C and D should be making good contact. After corrective action, verify that the signal input to terminals 13 and 14 appears at terminals 19 and 20

Step	Indication	Action
e.	Associated loudspeaker amplifier not muted when push-to-talk switch is depressed	Adjust contacts C and D of CARRIER ON relay so that they are closed when the relay is unenergized and open when the push-to-talk switch is depressed. If the relay cannot be energized, check its coil for continuity, the D and E contacts of the handset holder switch for good condition and correct adjustment, and the handset push-to-talk switch for good condition and correct adjustment. Clean, adjust, or replace as necessary. Verify that the relay is energized when the handset is held and the push-to-talk switch depressed
f.	Associated loudspeaker amplifier not muted when push-to-talk switch depressed, but switch and relay action is satisfactory	Attempt to secure desired muting action by adjustment of the speaker muting control. If this is not effective, measure the resistance of these dual potentiometers; replace them if this value is not correct

1-6 TRANSMITTING EQUIPMENT

GENERAL

Transmitting equipment includes R-F sources and modulators, in addition to transmitters. The simplest practicable transmitter for CW transmission consists of a power supply, an oscillator, and an R-F amplifier, as shown in the block diagram of figure 1-11. A more typical transmitter, with heavy lines showing the functions required for CW operation, is shown in the block diagram of figure 1-12.

A CW transmitter can be transformed to a radiotelephone, or phone, transmitter by the addition of a modulator, shown in dotted lines in figure 1-12. Although the modulator, frequency source, and power supply are usually parts of the transmitter, typical malfunctions involve only one of these at a time. Troubleshooting them is simplified because the malfunctioning section of the equipment can be troubleshot as a separate equipment, aside from power requirements. Preliminary troubleshooting procedures are given first and then procedures for transmitters, R-F sources, and modulators, which are followed by procedures for single-sideband transmitters. Power supply troubleshooting procedures are given in section 1-3 of this chapter.

MALFUNCTION INDICATION

Navy transmitting equipment is provided with meters to enable each equipment to serve as its own test equipment. By using them, the technician can determine what area of the circuitry can be responsible for a given malfunction. These indications are used extensively in the troubleshooting procedures following and enable much equipment performance to be evaluated without removing a chassis from the cabinet.

PRELIMINARY TROUBLESHOOTING PROCEDURE

Perform the appropriate steps in the following procedure if the approximate location of the malfunction is unknown. Use of this procedure will result in the correction of the malfunction or identification of which procedures to use in further troubleshooting.

Step	Indication	Action
a.	Transmitter gives no indication of being energized.	Verify that power switch is in correct position. Check line cord and plug for condition and correct insertion. Check the fuses and replace blown-out ones.

Step	Indication	Action
b.	Transmitter is energized but correct operation is not obtained.	Verify that all dial and switch settings are correct. If panel meters do not indicate the presence of the correct power supply voltages, use the power supply troubleshooting procedures of paragraph 5-3. At this time, determine in what way and on what functions (CW, SSB, 'PHONE, etc.) operation is impaired. Determine if it affects only certain bands or channels. Further define malfunction as no operation, operation at reduced power, inability to tune or load at a required frequency, inability to modulate properly, etc.
c.	Malfunction found only on one band or channel.	Inspect bandswitches for correct action in operation and proper adjustment and clean contacts; clean, adjust, and replace as needed to obtain correct operation. The visual inspection with equipment deenergized should be followed by a measurement of all voltage values affected by switching with equipment energized. Inspect and test components and connections switched in when malfunctioning band or channel is selected. If this is not effective, set the equipment to the malfunctioning band and continue with step d.
d.	Malfunction found only on one function (or several related functions).	Inspect all function-selection switches for correct operation, proper adjustment, and clean contacts; clean, adjust, and replace as needed to obtain correct operation. If this is not effective, inspect the condition of and test the operation of all circuitry switched into the circuit in the malfunctioning positions. This will include, for example, STANDBY, TUNE, 'PHONE, LSB, etc. If this is not effective, set the equipment for the malfunctioning operation and perform the following procedures where appropriate.
e.	Transmitter cannot be tuned to a desired frequency.	If no IPA drive is measured or if the frequency source cannot be tuned, follow the troubleshooting procedures of paragraph 5-6, R-F

Step	Indication	Action	Step	Indication	Action
OSCILLATOR OR FREQUENCY SOURCE MALFUNCTIONS. If the IPA cannot be tuned, follow the instructions for paragraph 1-6, TRANSMITTERS. If the PA cannot be tuned or loaded properly, follow the instructions for paragraph 1-6, TRANSMITTERS.			a.	PA PLATE CURRENT is not normal.	Verify that all dial and switch settings are consistent with known preliminary of calibrated settings. Verify that the IPA grid drive can be adjusted properly and then make the following adjustments - IPA tank, PA EXCITATION or GRID DRIVE, PA TUNING, and LOADING.
f.	The ANTENNA CURRENT meter indicates the presence of a carrier but does not indicate any power due to modulation.	If the MODULATOR CURRENT meter reading is normal and fluctuates with variations in input, perform step b. of paragraph 1-6, MODULATORS . If the MODULATOR CURRENT indication is abnormal; if modulation contains hum, distortion, or noise; or if undermodulation occurs, follow the appropriate steps of paragraph 1-6, MODULATORS .	b.	PA PLATE CURRENT is not normal, but PA GRID DRIVE is normal.	Test-substitute new PA tube(s) and try retuning. Test substitute dummy antenna at transmitter output or new transmission line and new antenna. Inspect and, where necessary, clean and adjust tank and coupling circuitry, switches, and antenna relay. Test-substitute new coaxial links if malfunction continues.
It is assumed that this or a similar procedure will be used to determine the approximate location of the malfunction and the appropriate steps to determine the approximate location of the malfunction and the appropriate steps to be used of the systematic troubleshooting procedures following.			c.	IPA GRID DRIVE and PLATE are normal but PA GRID DRIVE or GRID CURRENT are abnormal.	Test-substitute new PA tube(s) and test transmitter operation. Return original tube(s) to equipment if substitution does not improve operation. Inspect and, if necessary, clean and adjust contacts of all associated switches. Test condition of all components in network between IPA and PA stages.
TRANSMITTERS Perform the appropriate steps in the following procedure if the malfunction is thought to be in the transmitter IPA, PA, or following (coupling and antenna) circuitry. Test transmitter operation following any change (repair, replacement, or adjustment) to ascertain if normal operation has been restored.			d.	IPA GRID DRIVE normal but IPA PLATE CURRENT abnormal.	Test-substitute new IPA tube(s); return original tube(s) to equipment if substitution does not improve operation. Determine the condition of all switches and other components associated with IPA stage, especially in resonant network, coupling it to PA input.
NOTE In testing tubes, return each good tube to its ORIGINAL socket after testing. Replace defective tubes but keep in service tubes that test slightly low. Test-substitute a new and tested-good tube for one of questionable condition, but return it to stock and the old tube to the socket if the substitution does not improve the performance of the equipment.			R-F OSCILLATOR OR FREQUENCY SOURCE MALFUNCTIONS Use the appropriate steps in the following procedures to correct any malfunctions in the R-F oscillator, whether crystal-controlled or LC-controlled. Due to the wide variety of configurations and circuits used in R-F oscillators, the following troubleshooting steps have been broken down to cover specific conditions rather than type of equipment. The malfunctions covered are no R-F output, low R-F output, and off-frequency R-F output. Frequency synthesizers are so complex and of such differing configurations that this chapter does not attempt to		
CAUTION Observe all safety precautions, being sure to deenergize the equipment before removing a chassis and to discharge all filter capacitors before working on a chassis. In making resistance measurements, discharge all capacitors that could affect measurements or damage the ohmmeter.					

give a troubleshooting procedure for them. The general steps that apply to them, as well as to all other electronic equipment, are given in this section; the ET is referred to the appropriate technical manual for detailed troubleshooting procedures.

R-F OUTPUT IS UNSATISFACTORY ON ONLY ONE BAND OR CHANNEL (a). Use the following steps if a malfunction of any kind is experienced on one band, or one or a few channels, in the operation of a bandswitching or channel-switching frequency source.

Step	Indication	Action
a.	Impaired operation on one (or a few) bands or channels, characterized by no, low, or off-frequency output.	Inspect action of band- or channel-switches visually (equipment deenergized) and electrically (equipment energized). Verify that switching action is correct. Clean and adjust contacts.
b.	Same as step a. except switching action acceptable.	Test-substitute new oscillator tube. Also, if frequency is crystal-controlled, test-substitute new crystal of similar frequency.
c.	Same as step a. except switching, crystal, and oscillator tubes presumed good.	Verify (by VTVM or oscilloscope) that oscillator stage has no output on malfunctioning band or channels. Make oscillator socket voltage and resistance measurements; compare values found with normal ones given in the technical manual to identify possible defective components; replace any defective components.
d.	Same as step a. except switching, crystal, and oscillator tubes presumed good.	If the previous steps have been ineffective, set band switch or channel selector to a malfunctioning position and follow trouble-shooting steps appropriate for the type of malfunction encountered.

R-F OUTPUT IS ABSENT FROM FREQUENCY SOURCE. Use the appropriate steps among the following if no RF from the frequency source is found at the IPA stage.

Step	Indication	Action
a.	No RF present at IPA stage.	Use an oscilloscope or wave-meter to verify that the desired RF is not present at the input to the IPA or at the output of the frequency source. Check continuity of cables, connectors, and switches if it is present at the frequency source output but not at the IPA.

b.	No RF present at output of frequency source.	Test all tubes of frequency source on a transconductance tube checker. Discard those tubes which show a transconductance value less than half of the normal value or have internal short circuits. Return each acceptable tube to its original socket and replace discarded tubes with tested-good ones.
c.	No RF output from frequency source; tubes good.	Test-substitute a new crystal of a nearby frequency for each crystal in the frequency source.
d.	No RF output from frequency source; tubes and crystals good.	Use a VTVM or an oscilloscope to trace the R-F signal from the oscillator to the point where it cannot be found. Start with the oscillator plate and trace the signal to each following plate. When the signal is lost at a plate, determine if it is present at the grid of that stage; if not, it is lost in the resonant and coupling circuitry preceding. If the R-F signal is found at the grid, it is lost at the tube; substitute a new tube and make tube-socket voltage and resistance measurements to components found.

OUTPUT OF FREQUENCY SOURCE IS TOO LOW IN AMPLITUDE. Use the appropriate steps among those following if the R-F output of the frequency source is too low in amplitude to drive the IPA properly.

Step	Indication	Action
a.	R-F output of frequency source too low in amplitude.	Test all tubes of frequency source and any associated in the power supply on a transconductance tube checker. Discard those tubes which show a transconductance value less than half of the normal value or have internal short circuits. Return acceptable tubes to their original sockets and replace discarded tubes.

Step	Indication	Action
b.	R-F output of frequency source too low in amplitude, but tubes good.	Use the techniques of step d. R-F Output is Absent from Frequency Source , to identify any amplifier stage failing to produce the required gain or any other stage causing undesired attenuation. Some loss should be expected in passive circuitry (R-F transformers and networks), but amplifiers and multipliers should show some gain. Cathode followers should show a slight voltage loss.
c.	Abnormal attenuation found in an R-F transformer or resonant circuit.	Disconnect the suspected components from the circuit and test. Verify that the Q of inductors or assembled networks is within reasonable limits - under no circumstances below 10. Test suspected components by replacing them in the circuit.

OUTPUT OF FREQUENCY SOURCE IS OFF FREQUENCY. Note that the following steps are identified as being appropriate for large and small frequency errors, respectively. Large errors are considered to be those producing output at the second harmonic and above. Use the appropriate steps for the magnitude of the frequency error; note that small errors may remain after the large ones have been corrected.

Step	Indication	Action
a.	Frequency source output apparently in error.	Use a frequency meter series or equivalent to determine the output frequencies for various indicated frequencies. Determine from this data the magnitude and extent of the errors, their amount, and what band or channels they influence.
b.	Frequency source output is a harmonic of the indicated frequency.	Retune the frequency source, starting each adjustment from its low-frequency extreme (capacitor fully enmeshed) and peaking or dipping it at the first indication of resonance.

Step	Indication	Action
a.	Frequency source output is a harmonic of the indicated frequency.	Determine for a test setting what should be the frequency of the signal at each stage of the frequency source. Measure the frequency at each stage with a frequency meter and compare the measured and computed values for each stage to determine where the undesired harmonic originates. Determine the condition and Q of the resonating and filtering components involved. Make tube socket voltage and resistance measurements at that stage to locate any components resulting in incorrect operating conditions.
d.	Undesired frequency multiplication occurs in frequency source; all components apparently in good condition.	If the basic frequency is crystal-controlled, test-substitute known good crystals of the same or nearby frequencies. If this is not effective or applicable, try the following changes, in order: 1. Test condition of frequency-controlling or filtering components. 2. Place a tube shield around the oscillator tube if it does not already have one. 3. Place experimental shielding around oscillator stage circuitry. Check lead dress, particularly if it appears to have been altered. 4. Determine the condition of all filament and screen bypass capacitors at frequency source stages. Add them, where not already included in the circuitry, between these points and ground; disk ceramic capacitors of 0.005 uuf and a high enough voltage rating for the specific application are satisfactory.

Step	Indication	Action
e.	Frequency error is relatively small and originates at oven-enclosed crystal.	Check oven thermostat and heater operation. Monitor heater current and oven temperature, if necessary, to verify that current is at a maximum value until output temperature is reached, following which it is intermittent and cyclic around an equilibrium value. Make adjustments for correct equilibrium temperature, if necessary and possible, or replace any defective components - thermostat, heater, or entire assembly, if necessary.
f.	Frequency error is relatively small and originates at any type of frequency source.	Verify that the transmitter blower (if provided) is operating and that the ambient temperature and cabinet or console placement permit correct cooling. Correct any conditions responsible for poor cooling.
g.	Frequency error is relatively small; equipment cooling is satisfactory.	If output is crystal-controlled, test-substitute a known good crystal for the original one. If this is not effective (or in LC-controlled equipment), make oscillator socket voltage and resistance measurements to locate any components that may be causing incorrect tube operating conditions. Replace any such components.
h.	Frequency error remaining is small enough to be due to cumulative results of component aging.	Make calibration adjustments on oscillator trimmer capacitor, using an accurately calibrated LR-series frequency meter as a standard. LC-controlled channels are calibrated by alignment of one of the resonant components. Each continuously variable band is calibrated by a trimmer capacitor at the high frequency end and a padder capacitor or variable inductance at the low frequency end. The appropriate technical manual for the equipment gives detailed alignment and calibration adjustments in each case.

FREQUENCY ERRORS ORIGINATING IN FREQUENCY SYNTHESIZER. Many newer transmitting equipments provide frequency selection by switch control of a

frequency synthesizer. This provides for mixing the desired outputs of harmonic generators and frequency dividers, which are driven by a stabilized master oscillator. Since this equipment is complex and takes many forms, it is suggested that the ET called on to service it perform only steps a. and b. Step c. and d. should not be performed by ship-board personnel except in case of emergency. Steps c. and d. normally should be performed by tender personnel or a shore facility.

Step	Indication	Action
a.	Output of frequency synthesizer known to be off frequency.	Test all tubes on a transconductance tube tester. Tubes having a transductance at least half of the normal value and no internal shorts should be returned to their original sockets. Replace all other tubes with new ones.
b.	Frequency synthesizer known to be off frequency; tubes known good.	Make tube socket voltage and resistance measurements to locate defective components that alter operating conditions; replace such defective components.
c.	Frequency synthesizer known to be off frequency; tubes and operating conditions known acceptable.	Use an accurately calibrated frequency meter to compare the synthesizer output with the frequencies indicated by its control settings. Tabulate the amount of the error for each frequency at which error is found. Then use the equipment schematic or block diagram to locate the stages which could cause the errors noted. This is an analytical process, two examples of which follow. Example 1: Condition: Signals with 900 kc in their frequency designation (1.900 - 1.999 mc, 2.900 - 2.999 mc, etc.) are all supplied 100 kc low. Stipulation: The 900-kc component is supplied by a single frequency divider. Conclusion: Malfunctioning of this divider could result in the error noted. Example 2: Condition: Frequencies containing odd multiples of 1 mc are supplied 1 mc low in the output, duplicating the lower even-multiple range (1.9 mc being supplied as 0.9 mc, for example). Stipulation: Odd

Step	Indication	Action
		multiples of 1 mc are obtained by addition of 1.0 mc to the appropriate even multiple. Conclusion: Any stage generating or handling the 1-mc signal could cause this error.
d.	Frequency synthesizer known off frequency; possible sources of error identified.	Set frequency synthesizer for a known erroneous output. Determine what frequencies should be present in each of the potentially defective stages. Use the frequency meter to measure the frequency present in each of these stages until the malfunctioning stage is found. Make tube socket voltage and resistance measurements at this stage and replace any defective components found in this manner. If the defective stage functions as a frequency divider or multiplier, make the time-constant or resonance adjustments given in the equipment's technical manual for this stage, whether component replacements are made or not.

FREQUENCY CONTROL CIRCUIT MALFUNCTIONS.

Frequency control circuits are included in some R-F sources to lock the basic frequency setting so that one of its derivatives coincides with a derivative of a reference frequency. This circuitry may be located in a hermetically sealed and temperature-controlled enclosure. Because of the complexity of the circuitry, the technician is advised to perform the following steps first in case of malfunctions, performing the procedures given in the technical manual for the equipment only in case of emergency or if he has experience with this equipment.

Step	Indication	Action
a.	Frequency control circuit malfunctioning.	Test all tubes of frequency control circuit on transconductance tube tester, returning to their original sockets those tubes showing a transconductance at least 50 per cent normal and having no internal shorts.

Step	Indication	Action
b.	Frequency control circuit malfunctioning; tubes in good condition.	Make tube socket voltage and resistance measurements to locate any defective components; replace any found. Note that procedures in the appropriate technical manual must be followed in establishing conditions for the measurements.

SINGLE-SIDEBAND TRANSMITTERS

Only one sideband and no carrier (normally) is used for single-sideband (SSB) transmission (A3a emission). Specialized modulating and transmitting equipments are needed for this type of transmission. Some transmitters have been modified for SSB transmission, but all new SSB transmitting equipment is in the form of transmitters, rather than adapters.

THEORY OF SINGLE-SIDEBAND TRANSMISSION.

Several methods of obtaining SSB modulation have been devised, the most common one (figure 1-13) using balanced modulators (figure 1-14). Such circuitry and the heterodyning procedures used differentiate SSB transmitters from conventional A3 transmitters. The first balanced modulator shown in the example mixes audio (voice) with a 1.5-mc R-F signal to obtain only the sum and difference frequencies in the output. The narrow-band filter removes the lower sideband, passing only the sum frequencies. The oscillator and intermediate frequencies are specified in equipment design to facilitate sideband selection in the first filter and pass any of the desired R-F output frequencies through the second filter. The amplifiers used in this circuitry must be linear amplifiers—class A, class B, or a combination—as opposed to the class C stage commonly used as the power amplifier for A3 transmission.

All techniques for generating a SSB signal are similar in that the audio component is heterodyned with an R-F signal at a relatively low power and frequency level. Therefore, mixing (heterodyning) rather than multiplication techniques must be used to obtain the final radio frequency.

SINGLE-SIDEBAND ADJUSTMENTS. Single-sideband techniques depend on the accuracy and stability of oscillator and filter adjustments. These and modulator balance adjustments should be made, if necessary, after replacement of an oscillator or modulator tube.

The adjustments found in SSB transmitters follow, along with the purpose of each and the method of determining correct adjustment. Not all of these adjustments are found on every SSB transmitter, but many of them, plus the conventional transmitter drive, tuning, and loading adjustments, are part of every SSB transmitter. The letter designating each adjustment is given in figure 1-13 to show where the adjustment is located and also in referring to them in the troubleshooting procedure. The unlettered adjustment of carrier reinsertion amplitude is found only in ISB (Independent Sideband) equipment.

Designation	Adjustment of	Affect of Adjustment	Correct Adjustment Indication
A	Audio input level	Permit desired R-F output	A-C voltage at input
B	First Injection frequency	Permit retention of desired sideband and determine output frequency	Calibrated receiver or frequency meter at buffer amplifier output
C	First Injection signal amplitude	Permit optimum power-handling and output	R-F voltage at balanced modulator input
D	First modulator balance	Minimize carrier in output	Calibrated receiver or field strength meter
E	Sideband rejection filter band-pass	Pass desired sideband and reject other	Calibrated receiver or field strength meter
F	I-F buffer amplifier output level	Permit optimum power-handling and output (control sideband power in ISB operation)	A-C voltage at buffer amplifier output
	Carrier reinjection amplitude	Control pilot carrier amplitude	Calibrated receiver or field strength meter
G	Second Injection frequency	Determine output frequency — may be calibration for band tuning or adjustment for frequency channel selected	Calibrated receiver or field strength meter
H	Second signal amplitude	Attenuate input signals in modulated output	Calibrated receiver or field strength meter
J	Band-pass filter	Rejection of undesired frequencies	Sweep generator and receiver, or receiver

Designation	Adjustment of	Affect of Adjustment	Correct Adjustment Indication
K	R-F output amplitude	Permit optimum power-handling and output	R-F voltage at buffer amplifier output

The procedures and indications for the adjustments of any specific SSB transmitter are given in the technical manual.

The most critical adjustments are those of the first injection frequency and the sideband rejection filter bandpass. No adjustments should be made until the equipment has been installed and energized for a sufficient period (up to 6 hours for cold equipments) to reach its normal operating temperature. Frequency stability is improved by keeping the equipment heater power on at all times. This will also lengthen tube life and minimize equipment failure.

SINGLE-SIDEBAND TROUBLESHOOTING PROCEDURE.

Troubleshooting of SSB transmitters, as of other equipments, should be preceded by determining the nature and extent of the malfunction. Troubleshooting methods are similar to those for conventional A3 equipment (signal tracing, voltage measurements, etc.), but require more accurate adjustments and therefore more accurately calibrated test equipment.

The indications given in each step following identify the circumstances under which it is to be used. The first two are for inoperative transmitters, the third is a quick, 2-signal test for directing further troubleshooting, and the rest are for locating the stage and component in which any type of malfunction originates. All steps after c. require the use of an audio generator, as described in note following step b. These steps can be used without change in cases of no R-F output, with a signal tracer (such as Test Set AN/USM-3) or a suitable coupled receiver in cases of distortion, and with a VTVM or oscilloscope of suitable characteristics in cases of low output amplitude. Intermittent conditions are troubleshot by gently tapping transmitter components while monitoring the modulated output. Use the appropriate steps and test transmitter operation, either overall or at the point under study, following any change made in it. Adjustments required are identified by the letter under which listed in the table of SSB adjustments, paragraph 1-6, **SINGLE-SIDEBAND ADJUSTMENTS.**

Step	Indication	Action
a.	SSB transmitter completely inoperative; no panel lights or indications	Inspect fuses and replace any that are blown. Inspect power connections and verify that power is applied to the transmitter. If malfunction is not identified by this, follow appropriate procedures of Paragraph 1-3, POWER SUPPLIES

ORIGINAL

Step	Indication	Action
b.	SSB transmitter inoperative; power present but no output	Verify that all control settings are compatible with the preliminary or calibrated settings. Inspect panel meters to determine if proper voltages are present; if not, follow the appropriate steps of paragraph 1-3, POWER SUPPLIES.

NOTE

The following steps require the use of an audio input to the transmitter, since the correctly functioning SSB transmitter has no R-F output without an A-F input. Use an audio oscillator, set to 400-1000 cps and no more than half the microphone amplitude during normal speech, in lieu of the microphone input. Use a receiver tunable to the intermediate, radio, first injection, and second injection frequencies to sample the signal at the desired points in the transmitter.

c.	Transmitter has no R-F output.	Set up the audio generator in place of the microphone input, energize the equipment, and use the receiver, a wavemeter, or a frequency meter to test for the presence of the correct signal at the following points:
	R-F signal not at output of band-pass filter	Start at step d.
	R-F signal not at input of band-pass filter	Start at step e.
	I-F signal not at output of sideband filter	Start at step f.
	I-F signal not at input of sideband filter	Start at step g.
	If the R-F signal is obtained at each of these points but not at the transmitter output, follow the appropriate steps given in paragraph 1-6, TRANSMITTERS. Make alignment adjustment if required. Otherwise, start with the step given for the lowest test point at which the signal cannot be found — at step e, for example, if the R-F signal is not present at the band-pass filter input, but the I-F signal is present at the sideband filter output.	

Step	Indication	Action
d.	R-F signal present at input but not output of band-pass filter.	Adjust band-pass filter (adjustment J), following directions given in technical manual. Replace filter if it is apparently incapable of being correctly adjusted.
e.	I-F signal present at sideband filter output but no R-F signal at band-pass filter input.	Determine if the R-F signal is present at the output of the second modulator. If so, trace the signal through the R-F circuitry between the second modulator and the band-pass filter to locate the component responsible for the signal loss. Tube testing, voltage and resistance measurements, and tests of component condition can be used to locate defective components.

Step	Indication	Action
	R-F signal not present at second balanced modulator output.	Test for the presence of the second injection frequency and the I-F inputs to the modulator, using receiver, wavemeter, or oscilloscope.
	No second balanced modulator output, but both inputs present.	Troubleshoot the second balanced modulator stage by testing the tubes and measuring socket voltage and resistance. Replace any defective components found and make alignment adjustment I for second modulator balance.
	Second injection signal	Troubleshoot the second injection frequency oscillator circuitry, using the techniques of paragraph 1-6, R-F OSCILLATOR OR FREQUENCY SOURCE MALFUNCTIONS. Make alignment adjustments G (frequency) and H (amplitude) if required.
	I-F input to second balanced modulator is absent.	Trace for this signal in the circuitry between the sideband filter and the second balanced modulator. When the signal is found, determine the cause for its loss by testing tubes, making tube socket voltage and resistance measurements, and testing component condition.

ORIGINAL

Step	Indication	Action	Step	Indication	Action
		Replace any components found to be defective. Make alignment adjustment F, if needed, and verify that the R-F signal is present at the second balanced modulator output and at the transmitter output.			MODULATOR TROUBLE-SHOOTING procedure, paragraph 1-6, to correct the malfunction. Make alignment adjustment A if necessary.
f.	I-F signal present at sideband filter input but not at output.	Verify that input frequencies are correct (make adjustment B if necessary) and make alignment adjustment E of sideband filter, following directions given in transmitter technical manual. Replace sideband filter if it is apparently incapable of being adjusted correctly.		No first injection frequency input to first balanced modulator found previously.	Follow appropriate steps of paragraph 1-6, R-F OSCILLATOR OR FREQUENCY SOURCE MALFUNCTIONS , if signal-tracing shows that the oscillator is not operating correctly. Make alignment adjustment B of oscillator frequency and adjustment C of injection signal amplitude if required.
g.	I-F input to sideband filter is absent.	Determine if the I-F signal is present at the first balanced modulator output; if so, trace the signal from that point toward the sideband filter input. When the point of signal loss is located, use tube testing, voltage and resistance measurements, and component condition-testing techniques to identify the cause of the malfunction. Replace any defective components found and verify that the filter input is now present.	h.	Carrier present in R-F output.	Make alignment adjustment D (modulator balance). If the carrier is still present, check and, if necessary, readjust B (first injection frequency) and E (sideband rejection filter bandpass).
	No I-F signal at balanced modulator output.	Measure the amplitude of A-F and first injection frequency inputs to first balanced modulator. If both are present at the correct level, troubleshoot the balanced modulator by means of tube testing, tube socket measurements, and tests of component condition. Replace defective components, make modulator balance adjustment D, and verify that the correct output is now present.			
	No A-F input to first balanced modulator found previously.	Check all audio cables, connectors, terminals, and switches for continuity; use signal-tracing techniques, if necessary, to determine where audio signal is lost. If no modulation circuitry output is found, use the			

MODULATORS

The simplest transmission conveying information is a CW transmission—an A1 emission. The same equipment can be used for phone transmission if circuitry for amplitude-modulation of the A1 emission is added. This signal resulting is an A3 emission.

TYPES OF MODULATION. Plate modulation is usually used to produce an amplitude-modulated R-F signal in the manner shown in figure 1-12. Plate modulation circuitry must be able to add peak modulating power at 50 per cent of the carrier power. Only one-third of the total emitted power is modulated, even with 100 per cent modulation; the remaining two-thirds is transmitted at the carrier frequency. Full (100 per cent) modulation must not be exceeded in operation; "clipping" stages included in some modulators compress the A-F peaks to avoid such over-modulation.

Other modulation methods use circuits that control a grid potential in the R-F power amplifier stage. Figure 1-15 shows the stages needed for screen grid modulation, typical of the several types of power-amplifier grid modulation. Such modulators are different from plate modulation units in that a much lower power output is required to modulate the same level of R-F output.

MONITORING MODULATION. Transmitter modulation can be monitored during operation, or for test purposes, by an oscilloscope with the connections shown in figure 1-16. Note that neither a vertical nor horizontal signal goes through the oscilloscope amplifier stages. See paragraph 2-9.b.(2), NAVSHIPS 91828(A), Test Methods and Practices, for details.

The oscilloscope trace forms a vertical bar in the absence of modulation, as shown in figure 1-17(a). This bar broadens out horizontally with increasing modulation, to form a trapezoid, as shown in (b) for the 50 per cent and (c) for the 100 per cent levels of modulation. Modulation linearity is indicated by straight trapezoid sides. Bowed sides indicate nonlinear modulation, improper modulation circuit time constants, or signal sampling at an incorrect point in the circuitry.

Downward or zero-carrier overmodulation is indicated by a horizontal extension from the point of the trapezoid. Upward overmodulation is shown by the trapezoid height being more than twice the carrier-only height. Both types of overmodulation, although shown together in figure 1-17d, need not be present simultaneously.

This or any suitable method of checking modulation should be used if reports of signal distortion or "splattering" (transmission beyond the normal bandwidth limits) are received.

MODULATOR ADJUSTMENT. Modulator circuits require no operational adjustments as long as the R-F power level is unchanged. Undermodulation results from an increase in the R-F power level with no increase in modulating level. This has no adverse effects other than waste of power. Decrease in the R-F power level with no decrease in plate modulation power may result in overmodulation; the modulation (audio) power should be reduced proportionately to avoid this. MODULATION LEVEL or PER CENT MODULATION controls and the PER CENT MODULATION meter indication should be monitored during transmission. Their indications should be verified by use of an oscilloscope if modulation malfunction is reported or suspected.

MODULATOR TROUBLESHOOTING. Any type of modulator is essentially an audio amplifier which is coupled to a transmitter; modulator troubleshooting methods therefore resemble those for conventional audio amplifiers. Use the appropriate steps from those following to identify and correct any modulator malfunctions.

Step	Indication	Action
a.	Modulation is impaired.	Measure proper amplifier and modulator power levels to calculate power inputs; the audio input power should not exceed 50 per cent of the unmodulated R-F input power. Adjust either power for optimum operating conditions.
b.	No modulating power is applied at transmitter.	Measure the A-C voltage between chassis and the plate of each modulator output tube. A substantial indication should result when a voice enters the microphone. If it does, check continuity of any modulation transformer, modulation choke, cables, connectors, and terminals of

Step	Indication	Action
		associated circuitry in the modulator and transmitter power amplifier. Inspect and check component values of the associated network at the transmitter power amplifier grid.
c.	No audio output from modulator output tubes, as verified in step b.	Test all modulator circuit tubes on a transconductance tube tester. Replace any found having low transconductance or internal short circuits.
d.	Modulator has no output but tubes are all good.	Remove the modulator chassis and install a 5-k to 10-k resistor of sufficient wattage rating across the modulator output. An audio oscillator set to 400-100 cps and an amplitude comparable to a low microphone input is substituted for the microphone. A VTVM is used to read the A-C voltage on the plate (or cathode, of cathode followers) of each successive stage of the energized modulator, starting at the input and ending when the signal is lost. A voltage gain of over 20 is expected for each cascaded amplifier tube, but not for clippers, compressors, or phase inverters. None is found in cathode followers. When the expected gain is missing or a substantial loss is encountered, locate the defective component by tube socket voltage and resistance measurements and tests of component's condition. Typical causes of failure are low tube emission, gassy tubes, shorted bypass capacitors, and open or shorted coupling capacitors.

Step	Indication	Action
e.	Power-frequency hum is present in modulator output.	Test all tubes for internal short circuits and all filter capacitors for capacity, breakdown voltage, and leakage; replace any found defective. If hum is still present, capacity-couple a high-impedance headset to any point where the hum is found; substitute a resistor for the microphone; and use a 0.01-uf capacitor (with insulated clips on the leads) to shunt each grid, one at a time, to ground. Progress from input toward output until the hum disappears; its origin will be found in the circuitry between the grid shunted and the one before it.
f.	Intermittent noise is present in modulator	Pull at all cable connectors; probe all connections; and tap all components lightly with an insulated rod, with the modulator operating with dummy input, headset, and load as in step e.

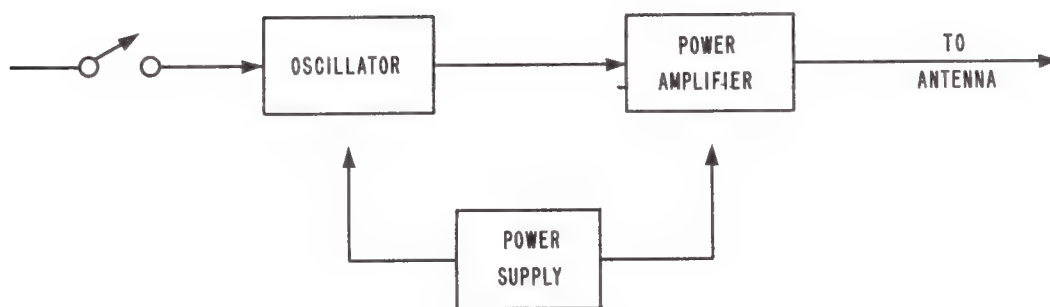


FIGURE 1-11 SIMPLE TRANSMITTER, BLOCK DIAGRAM

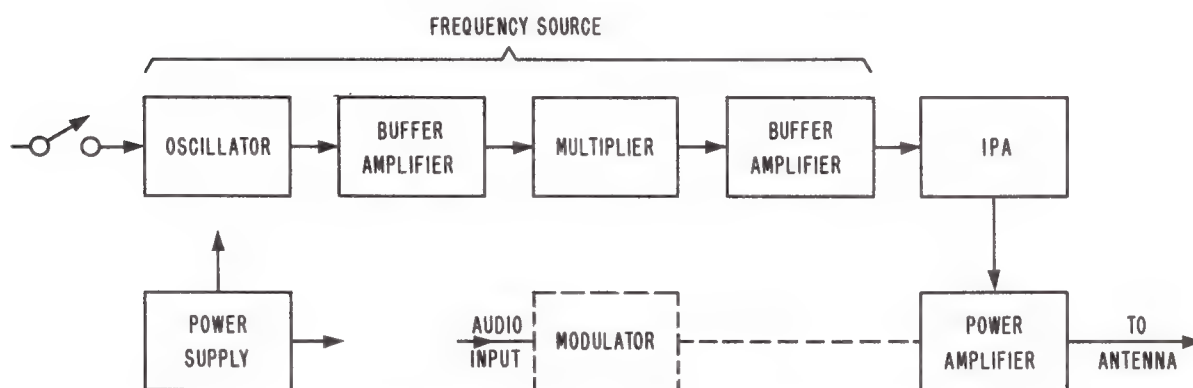


FIGURE 1-12 CW AND PHONE TRANSMITTER, BLOCK DIAGRAM (COMPONENTS NEEDED FOR CW OPERATION IN SOLID LINES)

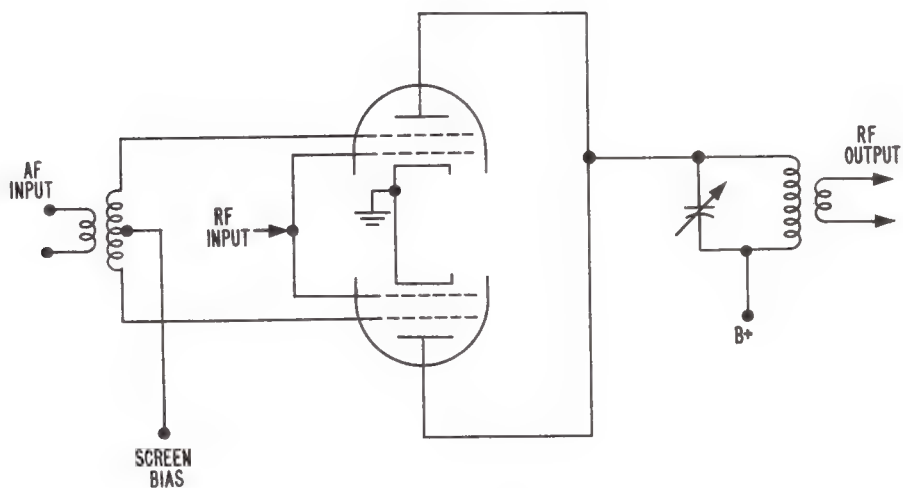


FIGURE 1-14 BALANCED MODULATOR CIRCUITRY

ORIGINAL

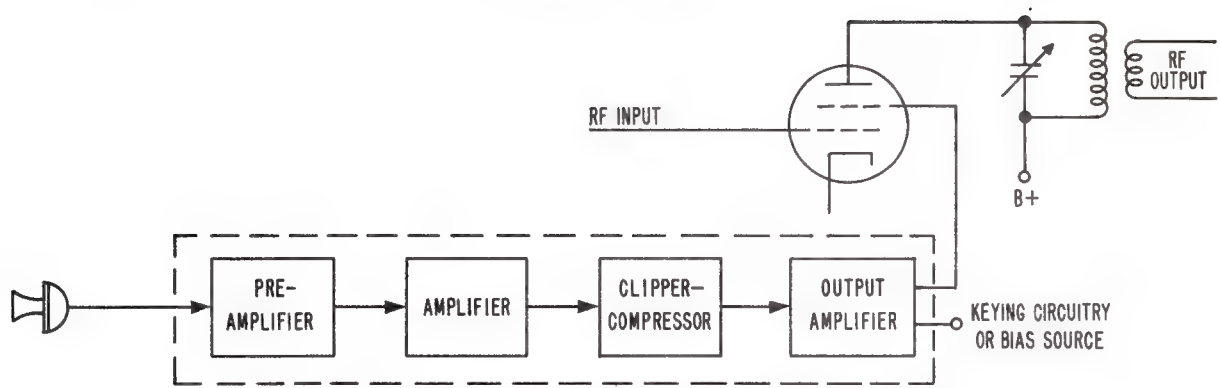


Figure 1-15 SCREEN GRID MODULATOR, BLOCK DIAGRAM

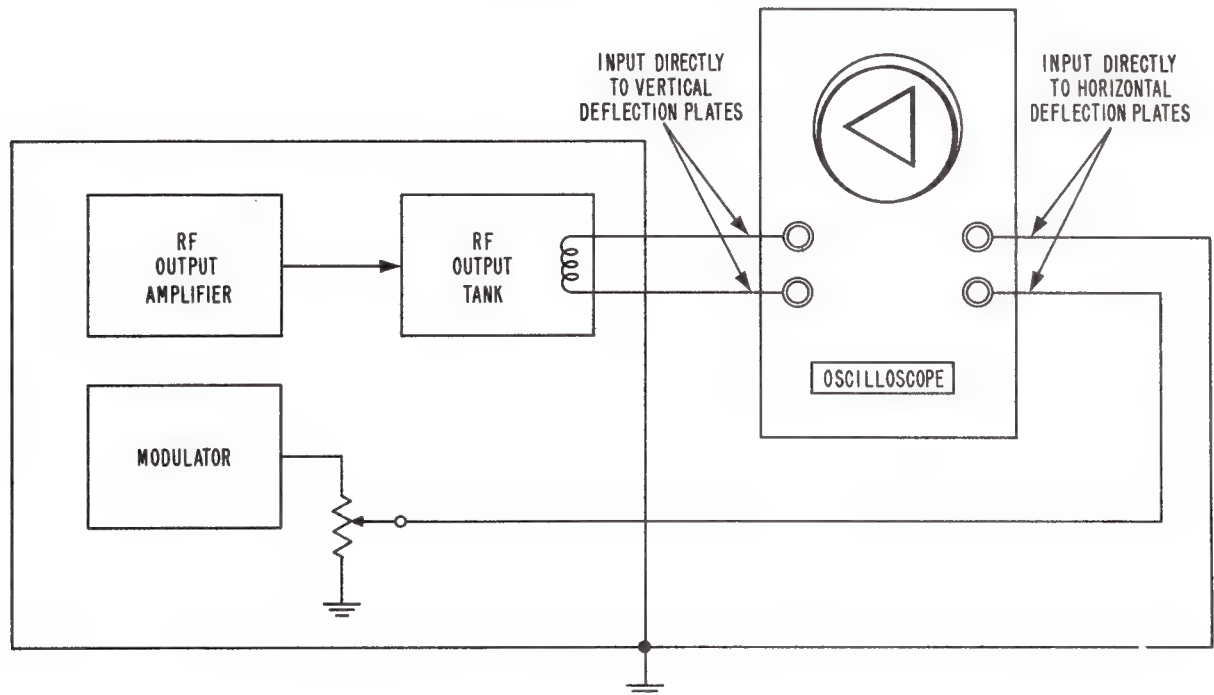


Figure 1-16 OSCILLOSCOPE CONNECTIONS FOR MONITORING MODULATION

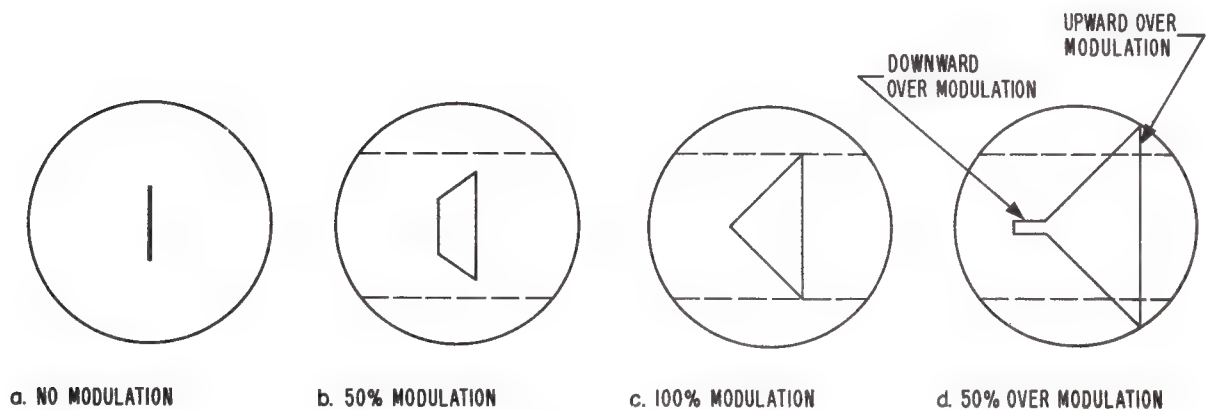


Figure 1-17 TRAPEZOIDAL MODULATION PATTERNS OBTAINED ON AN OSCILLOSCOPE

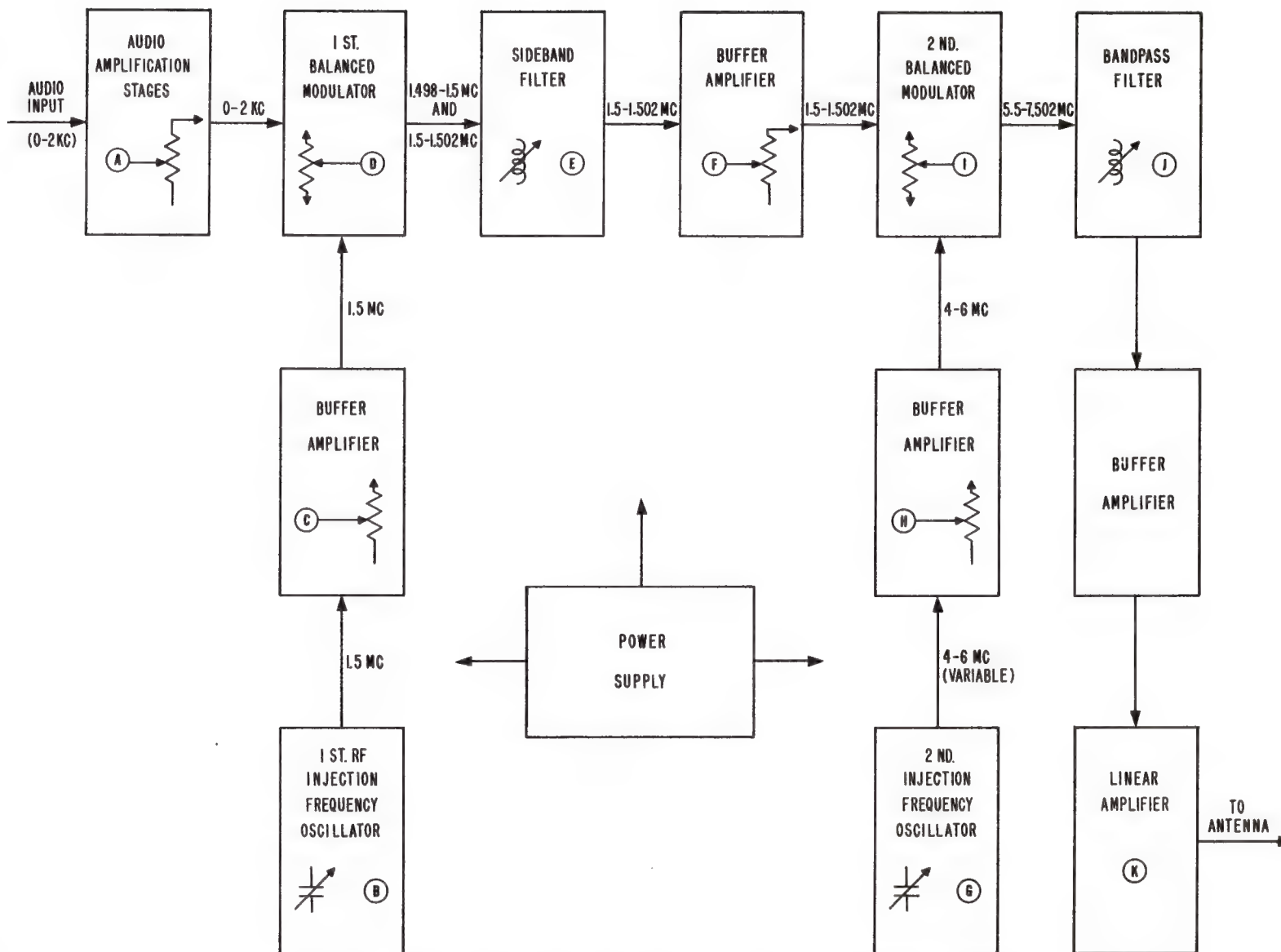


Figure 1-13 SINGLE-SIDEBAND TRANSMITTER, BLOCK DIAGRAM (ALIGNMENT ADJUSTMENTS IDENTIFIED BY CIRCLED LETTERS)

1-7 RECEIVERS

GENERAL

This section gives generalized alignment instructions and troubleshooting procedures for superheterodyne receivers. Single-side-band techniques and receivers are included, since SSB is now widely used in naval communications, but TRF, regenerative, and superegenerative receivers are not included.

A description of the configuration of stages needed and tabulation of alignment points for superheterodyne receivers is followed by preliminary and systematic troubleshooting procedures. These are divided into "front end" (RF and IF) AGC and detector, AF and SSB receiver troubleshooting.

RECEIVER COMPONENTS

The simplest possible receiver consists of a resonant circuit to select the desired frequency, a detector which rectifies the R-F signal to produce the A-F signal across its load resistor, and an electricity-to-sound transducer, all shown in figure 1-18. A "crystal set" is such a receiver and the now outmoded TRF (tuned-radio-frequency) receiver a vacuum-tube elaboration of it. These receivers can receive A2 and A3 signals, but cannot receive CW signals without modification.

The superheterodyne receiver is used in all types of radio communication because of its selectivity and adaptability to all types of reception. The simplest superheterodyne is shown in block-diagram form in figure 1-19, but more typical ones include more stages (dotted lines in the figure) for greater sensitivity and selectivity.

The heterodyning action of the superheterodyne receiver results from "mixing" the incoming R-F signal with another higher or lower R-F signal, generated by the receiver's local oscillator, figure 1-20. The local oscillator and R-F tuning capacitors are ganged together and adjusted to produce the same intermediate frequency for any R-F input frequency selected.

Some superheterodyne receivers are called "dual-conversion" receivers because they generate a second internal frequency to mix with the first I-F signal. This forms a second intermediate frequency which is detected in the conventional manner.

Fixed intermediate frequencies are used because they have the following advantages:

- a. Increased selectivity.
- b. Increased and more linear sensitivity.
- c. Easy filtering and feedback techniques for signal selection or rejection over the range of the I-F bandwidth.
- d. Bandwidth adjustment by front-panel controls is possible without adding greatly to circuit complexity.
- e. CW (A1) and SSB (A3a) reception is more practical by injection of a fixed beating frequency.

The BFO is used to provide a beat frequency which, when mixed with the I-F signal, produces an audio tone if a CW signal is present in the IF. It can be used also to supply the simulated carrier injected into the I-F circuitry for reception of SSB signals. The heterodyne product, when detected, yields the audio modulation carried by the SSB signal. Extreme stability is required of BFO's used for SSB reception.

Several types of detectors are used in superheterodyne receivers; the most common is a diode detector with an R-F decoupling network following, which is suitable for reception of all A-M signals. The product detector or balanced modulator (a form of mixer) is often used in detection of SSB signals, although the diode detector will work in this application. Ratio detectors and phase discriminators are used for F-M detection. Principles of detector operation will be found in the various electronics technicians rating manuals and in the ARRL Radio Amateur's Handbook.

AGC (Automatic Gain Control) circuitry or, as it is sometimes called, AVC (Automatic Volume Control) is included in receivers to make operation easier by reducing amplification of strong R-F peaks. It operates by supplying a biasing voltage to the grids of at least two early R-F or I-F stages, the bias increasing when strong signals are received. The biasing voltage is obtained from the AGC rectifier, which is often located in the same tube envelope as the detector diode. AGC action is disabled when a receiver panel switch is in the AGC OFF OR MANUAL GAIN CONTROL, rather than in the AGC ON position.

Single-sideband circuitry has some necessary and some desirable differences from conventional superheterodyne circuitry; the AGC rectifier samples the signal before BFO injection or detection and uses long time constants to maintain AGC action while no signal is present between periods of modulation (between words, for instance). Conventional superheterodyne communications receivers can be used for SSB reception if they have narrow-band filters, slow tuning rates, and stable BFO's. An SSB signal is received on such equipments by tuning on the sideband for maximum input indication and then setting the BFO by ear for intelligible reception.

Single-sideband reception is possible also with conventional receivers using single-sideband converters, as well as with specialized SSB receivers. SSB converters accept the receiver I-F signal, select the desired sideband by further conversion and filtering, detect by mixing the sideband with an injected carrier, and supply the demodulated signal at usual audio power levels. Tuning is done first at the receiver and then at the converter, across the receiver band-pass.

Specialized single-sideband receivers now coming into use have local oscillators of sufficient accuracy and stability to permit reception by just setting the receiver to the desired frequency; tuning by visual or aural indications is not required. The stability required is obtained in some complex equipment by deriving component frequencies from crystals and circuitry enclosed in ovens which are accurately maintained at specified temperatures. In other equipments of comparable accuracy and stability, the local oscillator frequencies are obtained from continuously - variable oscillators controlled by crystal-referenced circuitry, and operating to correct for any frequency error or drift.

SUPERHETERODYNE RECEIVER ALIGNMENT ADJUSTMENTS

Superheterodyne receivers can drift out of alignment after long use and consequent component aging. Some or all of the alignment steps following should be carried out under

these circumstances but should never be attempted unless it is certain that alignment is required. The need for some alignment adjustments is indicated by loss of selectivity and sensitivity, particularly if the various bands are affected to different extents. Also, alignment adjustments e. and f. may be required following replacement of the local oscillator tube and if the dial indications do not conform to the actual frequency being tuned.

Do not attempt alignment to correct a malfunction which has appeared suddenly, although in the course of troubleshooting one adjustment at a time may be altered slightly and then returned to its original setting.

Following is a list, Table 1-1, of alignment adjustments commonly found on superheterodyne receivers, whether used for conventional A-M, single-sideband, or F-M reception. Many receivers will not have all of the adjustments, but all continuously tuned receivers have the adjustments marked with an asterisk. The adjustments are listed in the order in which they occur in the circuitry. Specific frequencies, identification of adjustment points, and the order in which the adjustments should be made are given for each receiver in its instruction book.

Table 1-1. Superheterodyne Receiver Alignment Adjustments

Step	Adjustment of	Adjustment of	Controls or Calibrates
*# a.	Trimmer capacitor	1st R-F stage	Upper end of band
# b.	Padder capacitor or variable inductor	1st R-F stage	Lower end of band
# c.	Trimmer capacitor	2nd R-F stage	Upper end of band
# d.	Padder capacitor or variable inductor	2nd R-F stage	Lower end of band
*# e.	Trimmer capacitor	Local oscillator	Upper end of band
# f.	Padder capacitor or variable inductor	Local oscillator	Lower end of band
* g.	Capacitor or inductor	1st I-F transformer primary	Resonant frequency and bandpass characteristics
* h.	Capacitor or inductor	1st I-F transformer secondary	Resonant frequency and bandpass characteristics
* i.	Capacitor or inductor	2nd I-F transformer primary	Resonant frequency and bandpass characteristics
k.	Capacitor or inductor	3rd and additional I-F transformer primary	Resonant frequency and bandpass characteristics

Step	Adjustment of	Adjustment of	Controls or Calibrates
l.	Capacitor or inductor	3rd and additional I-F transformer primary	Resonant frequency and bandpass characteristics
m.	Detector balance (FM only)	Ratio detector or phase discriminator secondary	Null at no-signal condition

* Found on all receivers.

One such adjustment for each band or channel.

RECEIVER MALFUNCTION INDICATION

Receivers do not need the many indicators (meters and lamps) found on transmitters, but they are provided with some indicators that are useful in troubleshooting. Not all of these are commonly regarded as troubleshooting aids. Table 1-2 relates their indications to specific malfunctions. The variable indicated is given in the second column for each indicator and the corresponding malfunctions in the third column. Those indicators that are included with almost every receiver are identified by asterisks.

Table 1-2. Receiver Malfunction Indications

Indicator	Variable Indicated	Indication and Malfunction #
*POWER ON	Presence of filament power	Lamp out - Transformer failure, fuse blown, or no primary power
FUSE indicator lamp	Fuse blown	Lamp on - Fuse blown
B-plus lamp or meter	Presence of B-plus	Lamp off or meter reading zero - No B-plus
Output meter	Output power	Zero reading - Minimum output or no B-plus; detector or A-F circuitry if input meter reading okay.
*Loudspeaker or headset	Condition of audio output	Audible indications of: No AF - A-F circuitry and components (usually). Low A-F amplitude - Low sensitivity or defective A-F circuitry or components (if input meter reading is normal) Presence of too many signals - low selectivity. "Frying eggs" - Component (usually tube) noise. Hum - Tube or capacitor short or leakage. Crackling and "static" - intermittent connections or shorts.

Malfunction is based on assumption that indicator is functioning properly.

Analysis of the indications enables the experienced technician to identify the general area where the malfunction exists. Removal of the receiver and use of test equipment may be required then only to identify and replace the defective component.

The less experienced technician can locate the origin of the malfunction by noting the receiver's malfunction indications and using either cause-and-effect logic or the systematic trouble shooting procedures following. The Preliminary Troubleshooting Procedure is first used to determine which of the following procedures to use.

PRELIMINARY RECEIVER TROUBLESHOOTING PROCEDURE

These steps should be performed if the approximate location of the malfunction is not known. The receiver need not be removed from its cabinet or console to perform these steps.

Step	Indication	Action
a.	Malfunction of any kind affects only one band or some of the bands or channels	Perform the steps given in paragraph 1-7, SINGLE-BAND OR SINGLE-CHANNEL MALFUNCTIONS
b.	Receiver completely inoperative	Perform the steps given in paragraph 1-7, RECEIVER INOPERATIVE
c.	Input meter indications low and output absent, weak, or distorted	Perform the appropriate steps given in paragraph 1-7, FRONT END AND I-F MALFUNCTIONS
d.	Input meter indications are normal but output is impaired	Perform the appropriate steps given in paragraph 1-7, AGC AND MALFUNCTIONS , which may direct that the steps of paragraph 1-7, AUDIO MALFUNCTIONS , be performed
e.	Poor selectivity and/or sensitivity	Make alignment adjustments needed outlined in paragraph 1-7, SUPERHETERODYNE RECEIVER ALIGNMENT ADJUSTMENTS and given in detail in instruction book
f.	A3 reception normal, but no A1 reception	Test all components associated with BFO by means of testing tubes continuity, and resonating inductances, as well as making tube socket voltage and resistance measurements

RECEIVER INOPERATIVE

Perform the following steps in the order given if the receiver is inoperative, omitting any inappropriate ones. Test the receiver after each change made.

WARNING:

Observe all safety precautions in performing the following troubleshooting procedures.

Step	Indication	Action
a.	Receiver completely dead - POWER ON lamp and tubes unlit	Check fuse(s) and replace if blown. Follow procedures in paragraph 1-3, POWER SUPPLIES , if the fuse blows repeatedly. Inspect line cord and plug to make sure that they are in good condition and the plug is inserted correctly. Measure line voltage at receptacle and test - operate receiver at a known good receptacle
b.	Power input to receiver present but receiver dead - POWER ON lamp and tubes unlit	Use a VTVM or multimeter to test for input power at transformer primary. Refer to paragraph 1-3, POWER SUPPLIES , if power is found at the primary. If not, check for presence of input power at each power switch, interlock, fuse, and connector. Correct any open-circuited connections
c.	Tubes and panel lamps light but receiver output is absent	Test all tubes on a transconductance tube tester, first testing receiver operation after replacing any obviously bad (gassy or burned out) tubes. Return to original sockets any tubes having at least half their specified transconductance and no internal shorts
d.	All tubes test good but receiver output is absent	Use a VTVM to test for the presence of B-plus voltage at several plates throughout the circuit, including those of the audio output, local oscillator, and an R-F amplifier. If B-plus is missing at any point, search for and replace the defective component. If B-plus is absent entirely, follow the procedures in paragraph 1-3, POWER SUPPLIES

Step	Indication	Action
------	------------	--------

a.	Audio output absent or at low level	With the receiver withdrawn, set the R-F and AUDIO GAIN controls at their halfway settings and energize the receiver. Touch the tip of an insulated-handle screwdriver momentarily to each secondary terminal of the last I-F transformer. If a loud buzz or hum is produced at the speaker or headset, the following circuitry is operating; follow the procedures given in paragraph 1-7, FRONT END AND I-F MALFUNCTIONS . If no audio indication is obtained, apply the tip of the screwdriver to the center terminal of the AUDIO GAIN or VOLUME control. Follow the procedure given in paragraph 1-7, AGC AND DETECTOR MALFUNCTIONS , if a loud hum or buzz results. If it does not, follow the steps given in paragraph 1-7, AUDIO MALFUNCTIONS .
----	-------------------------------------	--

SINGLE-BAND OR SINGLE-CHANNEL MALFUNCTIONS

The steps of this procedure should be performed if a malfunction of any kind affects one or possibly two bands or channels. Test the receiver after each change made.

Step	Indication	Action
------	------------	--------

a.	No input indicated and no audible output when malfunctioning band selected	Determine the condition of the bandswitch or channel switch. Adjust and clean contacts, or replace switch if necessary
c.	No input indicated but contacts and switched components in good condition	Replace local oscillator tube and test operation on malfunctioning band. Try another new tube if this has no effect. Make alignment adjustments e. and f. of Table 1-1 for all bands if this replacement restores operation, otherwise make no adjustments and return the original tube to the socket. In this case, set the receiver to the malfunctioning band and continue troubleshooting with the procedures of paragraph 1-7,

FRONT END AND I-F MALFUNCTIONS

Step	Indication	Action
------	------------	--------

FRONT END AND I-F MALFUNCTIONS

The following items of test equipment, or their equivalents, should be used in troubleshooting receiver R-F and I-F circuitry:

1. R-F Signal Generator Set AN/URM-25 or AN/URM-26 (selection determined by frequency required)
2. Multimeter AN/USM-34
3. Test-Tool Set AN/USM-3, 3A
4. Dummy antenna, Navy Type 66017. (This can be constructed also by using the schematic diagram of figure 1-21 following, and enclosing the components in a small chassis or box for shielding. In emergencies, a 200- μ fd capacitor can be used in series with the antenna lead.

Perform step a. and the appropriate steps following the order given, and test the receiver after each change until the malfunction is located or corrected.

Observe all safety precautions in performing the following troubleshooting procedures. All final alignments should be done with the equipment enclosed as nearly as possible in its operating condition. Audible or metered audio output indications can be used in making adjustments; signals should be sampled at tuned stages (R-F, I-F and detector input) only in signal-tracing to locate the malfunction.

Step	Indication	Action
------	------------	--------

a.	No indicated input to receiver	Test all tubes in R-F, I-F, and AGC stages and replace defective ones as in paragraph 1-7, RECEIVER IN-OPERATIVE , step c.
b.	No I-F output, as tested in paragraph 5-7 Receiver In-operative, step e., but tubes known to be good	Replace the oscillator tube(s) with a new one and test the receiver. Try another tube(s) if this has no effect. Make alignment adjustments e. and f. of table 1-1 for all bands if the replacement restores operation, otherwise make no adjustments and return the original tube(s) to the socket
c.	No I-F output, but tubes are known to be good	Set the signal generator to the frequency of all last I-F transformer, modulated output, and 0.5-volt amplitude. Insert the signal across the secondary terminals of the last I-F transformer. If no receiver output is found at any setting of the AUDIO GAIN control and with AGC

Step	Indication	Action	Step	Indication	Action
		OFF, follow the steps of paragraph 1-7, AGC AND DETECTOR MALFUNCTIONS. If output is satisfactory, insert the signal between ground and the plate of the preceding stage (last I-F amplifier or second mixer) by means of a series capacitor. If no signal is present, replace the I-F transformer. If signal is present go to step e. for single conversion receivers and to step d. for dual-conversion receivers			
d.	Malfunction in I-F circuitry (FOR DUAL CONVERSION RECEIVERS ONLY)	Set the signal generator to the first intermediate frequency, modulated output, and 0.5-volt output amplitude. Use same receiver control settings as in step c. previous. Insert the signal at the second mixer signal grid; if an audio output does not result, the malfunction is in the second mixer or second oscillator circuitry. Use a VTVM to make voltage and resistance measurements at these two sockets; compare the measurements with the normal values given in the technical manual and replace any defective components found to be causing incorrect values. The oscillator is not operating if its normal negative bias is not present; in this case, test-substitute a new crystal (of the same frequency) or, if frequency is LC-controlled, check the L and C components. Then test-substitute a new oscillator tube, trying a second new tube if the first replacement does not restore operation. If the oscillator functions properly but no receiver output is obtained with signal injection at the mixer grid, use an oscilloscope with sweep set to a submultiple of the oscillator frequency to measure the amplitude and frequency of the second injection signal where applied to a grid of the second mixer.	e.	Malfunction in I-F circuitry (FOR SINGLE-CONVERSION RECEIVERS)	Insert a 0.02-volt modulated signal of the frequency last used (step c. for single-conversion and step d. for dual conversion receivers) at the signal grid of each I-F amplifier and the first mixer, progressing from last I-F amplifier to first mixer. Decrease the amplitude by a factor of 20 for each stage progressed. When a grid is reached from which the signal does not get through, insert the signal at the next HIGHER amplitude step at the plate just passed, using a capacitor in series to the plate terminal. If the receiver output is missing, test the condition of the I-F transformer following and the components in the grid circuit of the following stage. Replace any found defective. If the receiver output is regained with signal injection at an I-F amplifier plate, make voltage and resistance measurements at the amplifier socket, compare them with normal values, and replace any components causing abnormal values. If the grid voltage is more positive than normal, check leakage in the I-F transformer, driving it by removing the tube and measuring the dc voltage developed from transformer secondary to ground. Go to step g. if the I-F signal gets through to the receiver output, from the mixer plate, but not from its grid. Go to step h. if it is heard when inserted at the grid, but not at the antenna.
			f.	Receiver output present when signal injected at output of filter, but absent when signal injected at filter input	Check FILTER IN/OUT or ON/OFF switch for correct operation. Bypass the filter with a test lead and signal injected at earlier stage if an I-F transformer is not part of the filter. Replace filter if this restores operation or to test filter if it includes the I-F transformer.

Step	Indication	Action	Step	Indication	Action
	No receiver output, but first I-F transformer and all following circuitry is known operative, as tested in step e.	If the first I-F signal does not get through the mixer tube, step e., make voltage and resistance measurements at the mixer socket to identify components causing incorrect values. Replace defective components and verify that the receiver operates with the signal inserted at the mixer grid with both receiver and signal generator control settings unchanged from step e. If satisfactory operation results, make tests with injection of R-F signal, according to instructions in steps h. following	i.	No receiver output, but conversion and I-F circuitry are known operative	Retain the signal generator and receiver control settings used at the end of step h. and insert the signal at the plate of the last (if more than one) R-F amplifier. Increase the R-F amplitude to about 100 μ v. Absence of receiver output indicates that the malfunction is in the R-F tuned circuit or the bandswitch; test the components involved and switch adjustment and condition. Replace components or adjust, clean, or replace the switch to correct the malfunction
h.	No receiver output, but first mixer and all following circuitry known to be operative	If receiver output is not obtained at the end of step e. or g. use voltage and resistance measurements at the first local oscillator socket to identify components responsible for any incorrect values found. Absence of negative grid bias indicates that this stage is not oscillating; in this case, test the condition of and correct any defects in the L and C components and switches associated with this stage. Clean the tuning capacitor plates and inspect for damage or physical misalignment. Use an oscilloscope, if desired, to determine approximate oscillator frequency and amplitude at its plate and at the mixer grid coupled to it, using frequency-determining methods described in Test Methods and Practices, Navships 91828(A). When the oscillator is functioning correctly, set the injected frequency for the maximum output indication (using as little R-F GAIN as possible) to determine if the receiver is in alignment; if it is not, perform alignment adjustments steps e. and f. of table 1-1, for each band. Then test receiver operation with the same signal applied to the antenna terminals at the 5- μ v level.	j.	No receiver output, but last tuned R-F circuits and following circuitry known good	Reduce the signal generator amplitude by a factor of 20 and advance the signal injection to the grid of the grid of the last R-F amplifier tube. If the signal is not present at the receiver output, make voltage and resistance measurements at the tube socket. Replace any components causing incorrect values, and if audio signal is still absent, try tube substitution
			k.	No receiver output, but last R-F amplifier and all following circuitry known good	Retain same settings and transfer signal injection to the plate of the preceding R-F amplifier and follow the instructions of step i. for tuned circuit troubleshooting if no signal is found. Then use the procedures of step j. with the signal injected at the grid of this tube. Repeat these procedures with any additional R-F amplifier stages, being certain to reduce signal amplitude by a factor of 20 for each additional stage of amplification
			l.	No receiver output, but all amplifier stages known operating	If satisfactory receiver output results when the signal is injected at the grid of the first R-F amplifier but not when applied to the antenna terminals, check all associated connections and switch contacts for good continuity, and especially the

ORIGINAL

Step	Indication	Action
		latter for cleanliness and adjustment. Check condition of all associated components and replace those found defective. If receiver operation is not restored by these operations, try troubleshooting by inserting the signal at various points in the antenna tuned circuit

AGC AND DETECTOR MALFUNCTIONS

AGC (Automatic Gain Control) and detector malfunctions are identified by the following steps, some of which require an R-F signal at the receiver antenna terminal. This signal is provided by a signal generator set for a modulator 5- μ v or 10- μ v output at the same frequency to which the receiver dial is tuned. Perform the applicable steps following in the order given and test the receiver after each change to determine if acceptable operation has been restored.

Step	Indication	Action
a.	No or low receiver output; A-F signal present at detector output	Test AGC diode, detector diode, and tubes in all associated stages. Replace all tubes having internal shorts or a transconductance of less than half the normal value
b.	No or low receiver output when AGC On; tubes known good	Use VTVM to make voltage and resistance measurements at sockets of AGC and detector stages. Compare values with normal values to locate and replace components causing incorrect values. Note possible cause of high (positive) AGC voltage in step c.
c.	No or low receiver output when AGC either ON or OFF	Measure d-c voltages at AGC-controlled R-F amplifier grids and I-F transformer secondaries if AGC-line voltage is high-near zero or positive (see step e. of paragraph 1-7, FRONT END AND I-F MALFUNCTIONS). The positive voltage must originate at the most positive point along the AGC line. Test quality of suspected components and replace defective ones - usually an I-F transformer or tube

Step	Indication	Action
d.	No detector output, as determined in step e. of paragraph 1-7, RECEIVER INOPERATIVE	Make voltage and resistance measurements at detector socket, locate components having incorrect values, and replace them

AUDIO MALFUNCTIONS

Perform the following procedures to locate and correct audio malfunctions, using, where required, a modulated 5- μ v or 10- μ v signal applied to the antenna terminals, at the same frequency to which the receiver dial is tuned. An audio generator connected to the audio gain control can be used instead if it has been established that receiver operation is satisfactory up to that point.

Step	Indication	Action
a.	No receiver output when signal injected at detector output as tested in step e. para-1-7, RECEIVER INOPERATIVE	Test all tubes in the audio stages and replace all those having internal shorts or a transconductance less than half of the normal value
b.	No receiver output; A-F output from detector known present and tubes known good	Use the signal tracer to probe for the audio signal at each of the following points and at an amplitude greater than that used at the GAIN control by the factor in parentheses: (1) AUDIO GAIN control, center tap (2) Grid of first audio amplifier (1) (3) Grid of second audio amplifier (20) (4) Grid of third and following audio amplifiers (400, etc.) If the signal is absent at a grid, test for its presence at the preceding plate. If it is not found there, make voltage and resistance measurements at the socket of that stage, locate components causing incorrect values, and replace them. If the signal is found at the plate tested previously, determine the condition of the components coupling the two stages. Remove the tube following and measure the d-c voltage (for indication of leakage) on

ORIGINAL

Step	Indication	Action	Step	Indication	Action
		the grid side and the signal amplitude (for indication of coupling) on both sides of the capacitor.			Check all components in this stage and replace that introducing the hum-usually a tube filament-to-cathode short, which may appear only when the tube is hot. Tube substitution will be necessary to identify this cause. Lead dress may be critical and can be experimented with if it has been previously altered
c.	No receiver output but A-F and all preceding circuitry functioning	Test for presence of B-Plus voltage at both plate and B-plus terminals of the output transformer; replace the transformer if B-plus is applied to the transformer but is absent from the plate terminal			
d.	No receiver output, but all circuitry through output transformer primary is functioning	Use signal tracer or headset to sample the A-F signal at the output transformer secondary terminals. If absent, check again in with the load replaced by an equivalent resistive load. Replace the transformer if the signal is still absent and no short or open circuits are found. If the signal is absent across the dummy (resistive) load, troubleshoot the normal load by means of component substitution and inspection of the output jacks for correct contact operation	g.	High hum level originating in A-F circuitry present in receiver output	If the hum level was unchanged by variation in AUDIO GAIN setting, the hum originated in the circuitry following the volume control - the A-F circuitry. Use the methods of step f. to locate stage in which the hum originates
			h.	Intermittent noise present in receiver output	Lift one side of the energized receiver (with antenna shorted) a quarter of an inch above the work bench surface and let drop. If no change in intermittent noise results and if noise is constant in occurrence, follow the procedures of steps f. and g. to locate the stage and component causing the noise
e.	High hum level present in receiver output	Test the condition (capacity, voltage withstand, and leakage) of all B-plus filtering capacitors in the receiver. If this is not effective, test all tubes and replace those with internal shorts	i.	Intermittent noise present in receiver output in response to mechanical vibration	If dropping the side of the receiver slightly in step h. previous altered the noise momentarily, locate its origin by varying the AUDIO GAIN setting as in step f. previous. If increasing the setting increases the volume of noise, use a small (one-fourth diameter) alignment tool to gently tap each tube in succession, beginning with the first R-F amplifier and ending at the last I-F amplifier. In evaluating intermittent noise, bear in mind that the tube characteristics for front-end applications result in microphonic effects, which are amplified by the stages following. Tap each tube at least once from directions 90° opposed. Test-substitute a new tube for one producing a high level of intermittent
f.	High hum level present in receiver output; tubes and test good	Short or ground the receiver antenna input for all following tests. Vary the AUDIO GAIN control between its two extreme positions. If the hum changes in level in response to this it originates in the R-F, I-F, or detector circuitry. Locate the stage originating the hum by use of a 0.1-ufd capacitor to short the signal to ground at each R-F and I-F amplifier grid in succession, starting at the first R-F amplifier and finishing at the last A-F amplifier. At the point where the hum disappears, the capacitor must be shunting it to ground within the stage following its source.			

ORIGINAL

Step	Indication	Action
		noise. If this is not effective, return the original tube to the socket and tap each associated component under the chassis to find the one that is sensitive to vibration. Typical causes are microphonic tubes, poor electrical connections, and occasionally defective components

SINGLE-SIDEBAND RECEIVERS

It was noted in paragraph 1-7, *Receiver Components*, that SSB signals can be received by any of the three following means:

- a. A conventional communications receiver (preferably one having SSB-adapted AGC circuitry, narrow-band filters, slow tuning rate, and a stable BFO).
- b. A conventional receiver used in conjunction with a SSB converter to supply the desired filtering, injected carrier stability, and sideband selection.
- c. A specialized SSB receiver with frequency-setting precision and stability permitting reception at a specified frequency without requiring any tuning indication or having any subsequent drift.

Malfunctions in conventional receivers can be identified and corrected by use of procedures given previously. Many of these procedures are useful in SSB troubleshooting also; those following can be used without change:

RECEIVER INOPERATIVE.

SINGLE-BAND OR SINGLE-CHANNEL MALFUNCTIONS.

AGC AND DETECTOR MALFUNCTIONS.

AUDIO MALFUNCTIONS.

The previous steps should permit troubleshooting all of the specialized SSB receiver except for frequency synthesis, comparison and control; heterodyning; and detection circuitry. Analysis of any frequency generation and control malfunctions or use of the SSB troubleshooting procedures, **SINGLE-SIDEBAND RECEIVER TROUBLESHOOTING**, will determine the further procedures to be used. Some of the R-F oscillator or frequency source malfunction procedures in the transmitter section of this chapter will be useful in troubleshooting the SSB receiver frequency generation circuitry. These procedures are listed following and are referred to in paragraph 1-7, **SINGLE-SIDEBAND RECEIVER TROUBLESHOOTING**.

R-F OUTPUT IS UNSATISFACTORY ON ONLY ONE BAND OR CHANNEL (S).

R-F OUTPUT IS ABSENT FROM FREQUENCY SOURCE.

OUTPUT OF FREQUENCY SOURCE IS TOO LOW IN AMPLITUDE.

OUTPUT OF FREQUENCY SOURCE IS OFF FREQUENCY.

FREQUENCY ERRORS ORIGINATING IN FREQUENCY SYNTHESIZER.

FREQUENCY CONTROL CIRCUIT MALFUNCTIONS.

PRINCIPLES OF SINGLE-SIDEBAND RECEPTION. The characteristics of the single-sideband emission are given in paragraph 1-6, **SINGLE-SIDEBAND TRANSMITTERS**. In A3 communication, audio intelligence is transmitted as simultaneous beat frequencies between the carrier and the many radio frequencies forming the sidebands, but in SSB transmission there is no carrier and hence no beat notes. The simplest means of obtaining SSB reception is by using a conventional receiver, which supplies a beat oscillator frequency as a "substitute carrier" to beat with the sideband frequencies. This "substitute carrier" is inserted as an intermediate frequency, and diode detection is used. Unfortunately, there is no such thing as an "exact" frequency setting on most such receivers, and the beat oscillator frequency requires periodic resetting to retain intelligibility.

These inadequacies of the conventional communications receiver are retained when a single-sideband converter is used in conjunction with it. Tuning precision and frequency stability are limited by dial readability and local oscillator stability, although sideband tuning and filtering are improved with use of the converter.

Recent receivers designed specifically for SSB reception incorporate elaborate means for frequency selection, control, and compensation. Some of the more common are:

- a. Use of a crystal oscillator and selection of frequency-dividing and frequency-multiplying circuits to produce reference signals at the desired frequencies.
- b. Enclosing temperature-sensitive, frequency-determining circuits in an extremely stable crystal oven.
- c. Use of frequency comparison circuitry to compensate for error or drift of the individual injection frequencies.

Many of these equipments obtain heterodyning frequencies from free-running oscillators, the frequencies being compared with and maintained at the selected reference frequencies.

Local oscillator stability is increased by using step-type LC selection of harmonics of stable frequencies, which are obtained by division of a crystal-controlled frequency. This fundamental frequency can easily be calibrated by comparison at a test point with a Ships Standard Frequency or WWV transmission. The accuracy resulting is far greater than could be obtained by continuously variable or step-type LC control of the oscillator. In some equipments, the desired frequencies are set by switching, the local oscillator tuned to the identical frequency, and error- and drift-compensating circuitry used in the generation of a heterodyning frequency to keep the total of the beat frequencies stable. The step-type control permits the receiver to be set to a scheduled frequency, rather than tuned to a received signal.

Single-sideband R-F signals can be obtained in one method, by phasing processes resulting in the suppression of the carrier and one sideband. Balanced modulators can be used in a more common method since they obtain the difference and sum frequencies but exclude the input frequencies from the output. The desired sideband can be retained by filtering after the balanced modulator in a transmitter; this sideband is selected by filters before demodulation in a receiver, but the balanced modulator itself is the same in both applications. Several such balanced modulators can be used in specialized SSB receivers for obtaining successive sum

and difference frequencies, as shown in figure 1-22. The final frequency injected restores the carrier; no additional demodulation stage is needed.

ALIGNMENT ADJUSTMENTS ON SINGLE-SIDEBAND RECEIVERS. Single-sideband receivers have R-F and I-F alignment adjustments that are similar to those of the conventional superheterodyne receiver, in addition to those required for SSB receivers only. These additional adjustments are injection oscillator amplitude, modulator balance, sideband selection filters, and the source frequency. Oscillator frequency adjustment to retain dial calibration may be required as a result of normal component aging and following replacement of an oscillator tube. Balance adjustment may be needed for modulator tubes, following their replacement or replacement of an associated component, to minimize any input frequencies appearing in the output.

The functional block diagram of one type of SSB receiver front end is shown in figure 1-23. Note that the desired frequency is selected by setting the proper reference frequencies and then tuning the associated oscillators to each component of the reference frequency by means of tuning indicators. The R-F circuits, first (HF) oscillator, and harmonic selector filter are ganged together in such equipments, requiring precise alignment for good tracking. Some equipments make use of a variable I-F frequency, with the added requirement that the variable I-F transformers be aligned to track with the ganged components noted previously.

SINGLE-SIDEBAND RECEIVER TROUBLESHOOTING. The following procedures are to be used in troubleshooting specialized SSB receivers. They refer, where appropriate, to steps used in troubleshooting conventional receivers.

Test equipment of precision and stability comparable to these receivers should be used in making alignment and calibration adjustments. Frequencies can be measured by means of an electronic counter (EPUT counter) calibrated as a secondary standard.

Use the appropriate following steps in case of malfunction, testing the operation of the receiver or the defective stage after making any change or adjustment.

Step	Indication	Action
a.	Receiver inoperative	Follow appropriate steps of paragraph 1-7, RECEIVER INOPERATIVE , except in step e. substitute the steps following for those of the paragraph 1-7, FRONT END AND I-F MALFUNCTIONS , reference. Step c., tube testing, may be deferred if receiver has many tubes, and none are obviously defective.
b.	Operation on one band or channel(s) absent or impaired.	Follow appropriate steps of paragraph 1-7, SINGLE-BAND OR SINGLE-CHANNEL MALFUNCTIONS .

Step	Indication	Action
c.	Receiver output is absent or impaired; input meter gives normal indications, but output meter indication is low or absent.	Follow the appropriate POMSEE step to determine the condition of the receiver A-F circuitry. If no such step is found, inject a 0.5-volt A-F signal at the center tap of the AUDIO GAIN control; receiver A-F circuitry is operative if normal receiver output is obtained. Proceed to step d. If A-F operation is satisfactory. Use steps given in paragraph 1-7, AUDIO MALFUNCTIONS , to identify and and correct the cause of any audio malfunction found.
d.	Receiver output is absent or impaired, but A-F circuitry is known to be functioning correctly.	Set an R-F signal generator for a 0.5-volt unmodulated carrier output at a frequency differing from the receiver's last intermediate frequency by an audio beat. Apply this signal to the grid of the first I-F amplifier preceding signal demodulation. (If necessary, swing the generated signal across the known intermediate frequency until tuning setting is found.) If normal output is present, test preceding I-F stages of this frequency by applying the signal (reduced in level by a factor of 15 or 20 for each stage) to each preceding grid in turn. Proceed to step e. If indications of normal reception are found. Use techniques of tube testing or tube substitution, signal tracing, tube socket measurements, and measurement comparisons to locate the point where the signal is lost or impaired. Use step c. of paragraph 1-7, AGC AND DETECTOR MALFUNCTIONS , if AGC-controlled grid voltage is too high. Use an oscilloscope with horizontal sweep triggered by an accurately calibrated oscillator to determine (by use of Lissajous patterns) the injection frequency. Trace it from

Step	Indication	Action	Step	Indication	Action
		mixer used. If the injection signal is absent, use the appropriate troubleshooting procedures of paragraph 1-6, R-F OSCILLATOR OR FREQUENCY SOURCE MALFUNCTIONS. If it is not at the correct frequency, make the required adjustment.			
e.	Receiver output is absent or impaired, but A-F and last I-F circuitry are known to be functioning correctly.	Set the signal generator to the next-to-last intermediate frequency used, output unmodulated and attenuated by a 1/20 factor for each amplification stage. Inject this frequency in turn at each grid having such an input. Proceed to step f. If normal indications are found when receiver is operated. If the normal signal is absent or impaired at any grid tested, follow the procedures of step d. to test for the presence of the required heterodyning injection frequency and to test the circuitry involved. Follow the corrective measures given.	f.	Receiver output is absent or impaired, but receiver is operative from the next-to-last I-F stage onward.	Set signal generator to any further intermediate frequency used, unmodulated output, and a level determined by the number of amplification stages following the injection point. Use the test procedures and corrective measures given in preceding steps d. and e. to correct any malfunctioning.
			g.	Receiver output is absent or impaired, but is known to be operative from first I-F stage onward.	Use Lissajous-pattern presentation to determine the first injection frequency. Adjust the signal generator for a frequency having an audio difference from the frequency to which the receiver is tuned (unmodulated and at a 100- to 1000-uv level) and inject it at the grid of each R-F amplifier in turn, progressing from the first balanced modulator or first mixer to the receiver antenna input. Use general malfunction-isolating procedures given previously to identify malfunctions in the area where the injected signal is lost. Do not overlook the condition of switch contacts or R-F inductors. the oscillator to the grids of the associated modulators or

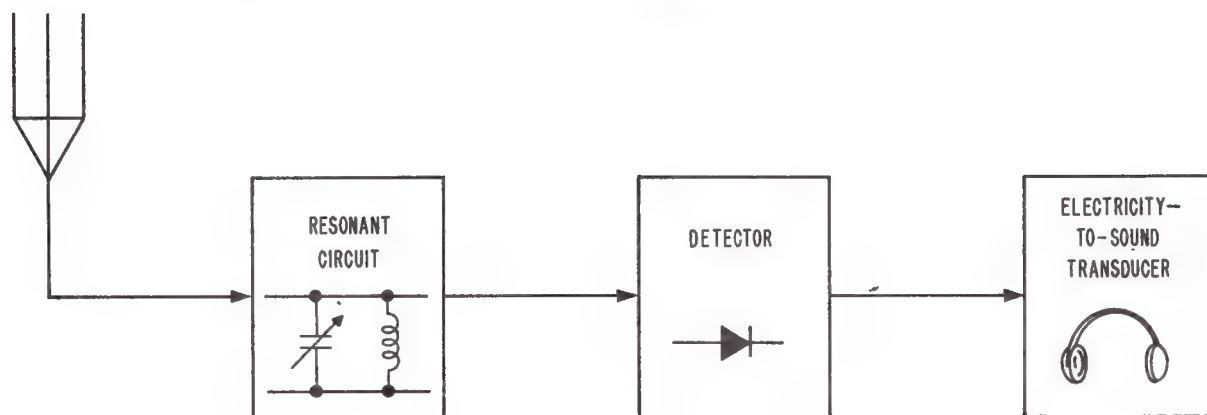


FIGURE 1-18 SIMPLE RECEIVER, BLOCK DIAGRAM

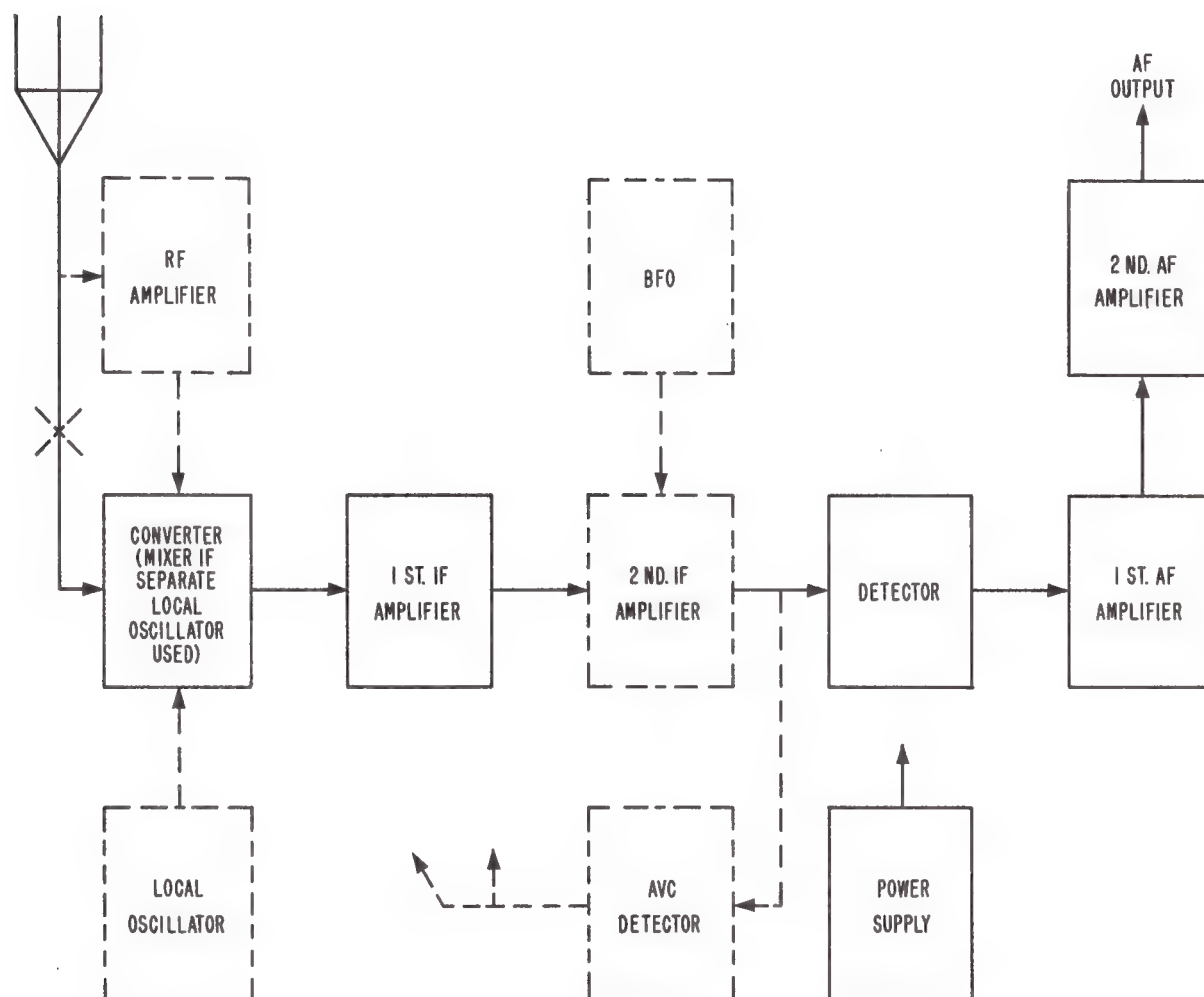


FIGURE 1-19 SIMPLE SUPERHETERODYNE RECEIVER, BLOCK DIAGRAM (STAGES ADDED FOR TYPICAL COMMUNICATIONS RECEIVER SHOWN IN DOTTED LINES)

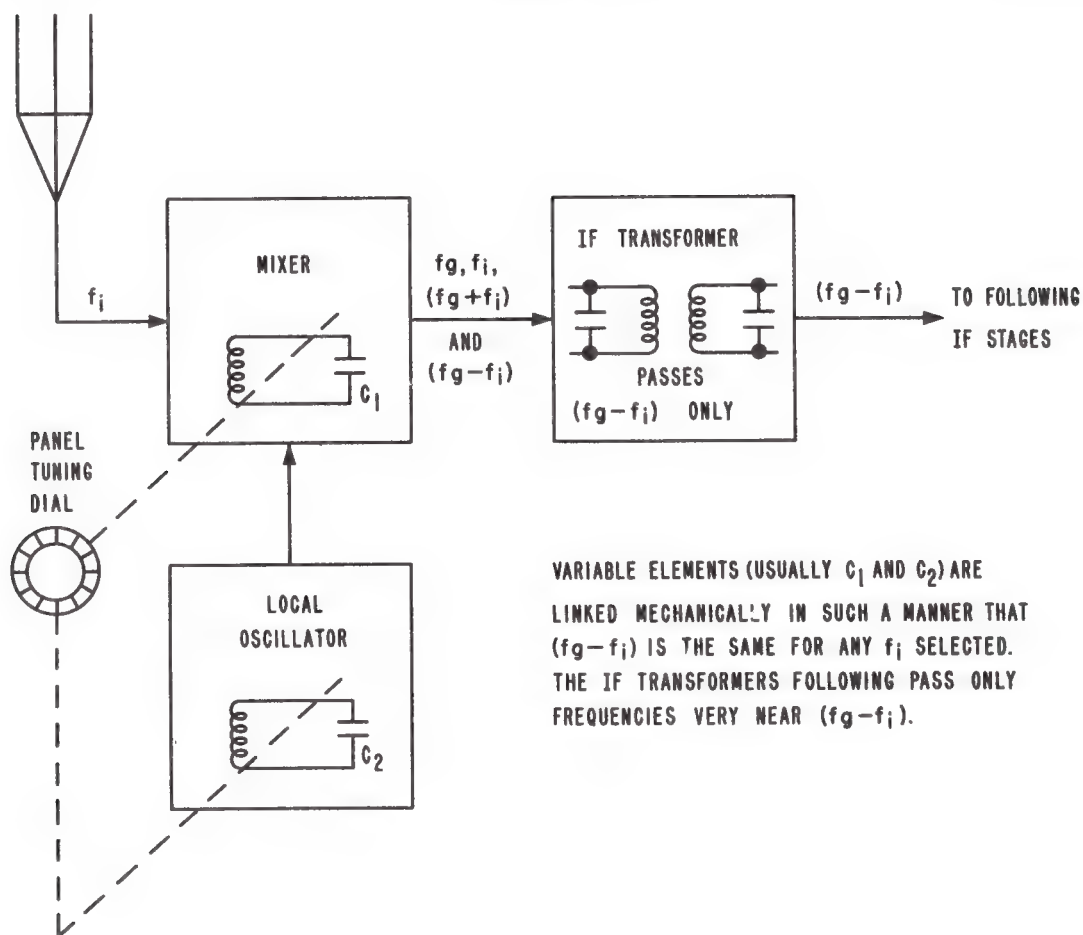


FIGURE 1-20 HETERODYNE ACTION IN SUPERHETERODYNE RECEIVER, BLOCK DIAGRAM

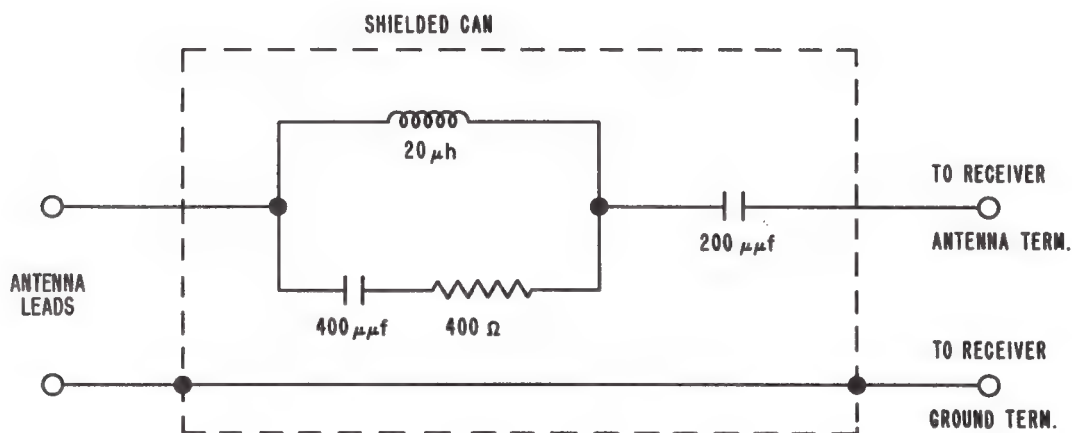


FIGURE 1-21 RECEIVER DUMMY ANTENNA, SCHEMATIC DIAGRAM

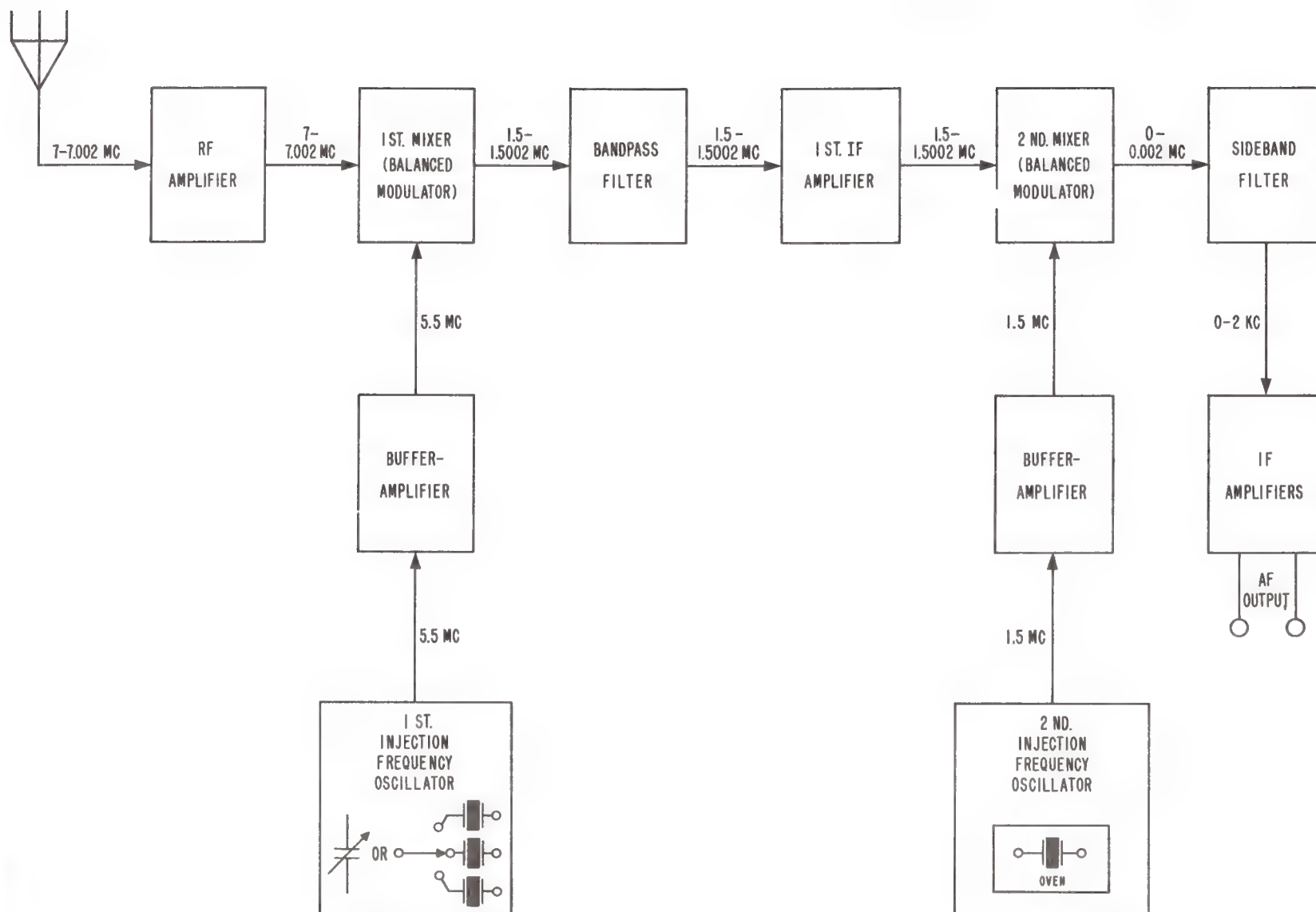


FIGURE 1-22 SINGLE-SIDEBAND RECEIVER, BLOCK DIAGRAM

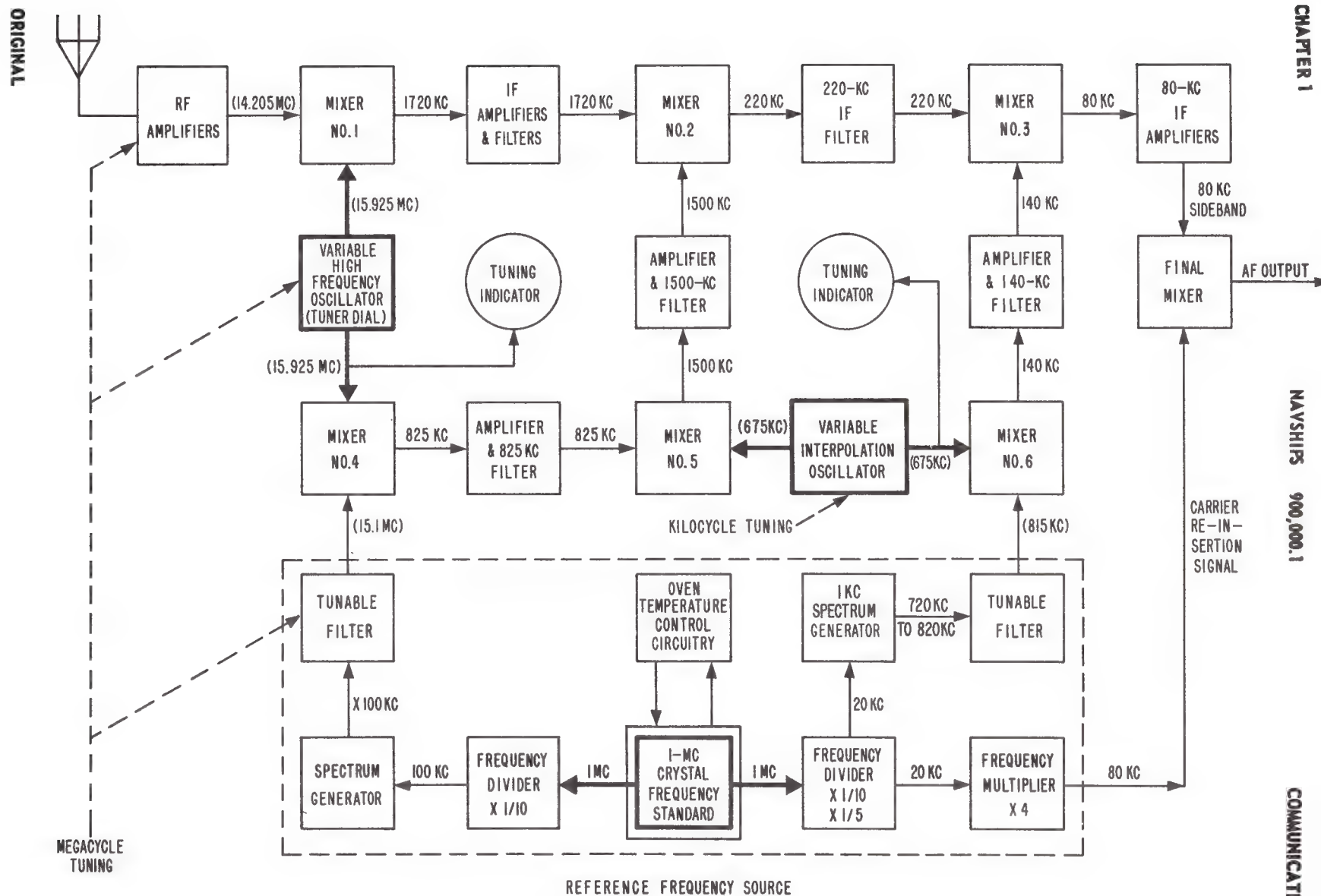


FIGURE 1-23 SSB RECEIVER FRONT END, USING FREQUENCY SYNTHESIZER AS FREQUENCY REFERENCE FOR

1-8 TERMINAL EQUIPMENT

GENERAL

Terminal equipment is needed to enable special types of signals to modulate radio transmissions and, at the receiving end, to enable receiver outputs to operate monitoring and recording devices. Its most common use is to modulate radio transmissions by the start-stop, pulse-type code used by teletypewriters and, at the receiving end, to transform the 2-tone signal received back into the start-stop code.

Basic troubleshooting procedures are given in this section for the keyers (transmitting) and the converter and converter-comparators (receiving) used for teletype FSK (frequency-shift keying, on F1 emissions) and facsimile (on F4 emissions) communication. Local distribution systems and power supplies are described briefly, but electronic cryptographic equipment is not covered.

Because of the unrelated natures of terminal equipment, this section is divided by equipments. In troubleshooting terminal equipment, use the steps given for the particular symptoms noted under the equipment being serviced. Test the equipment either partially or in its entirety after any repair or adjustment is made.

TELETYPE AND FACSIMILE KEYERS

Keyers are used to transform the on-off (neutral) or plus-minus (polar) teletype signal into F1 (frequency-shift keyed) R-F signals, the frequency shifts occurring in response to changes in level of the teletype signal. The keyers in use can accept an R-F signal from an external source, usually a transmitter, or can generate their own crystal-controlled RF. The keyer output can be used to drive any R-F stage of the transmitter requiring a 20-volt a-c signal.

Many keyers can modulate in response to voltage variations between the extremes of teletype signal levels, as well as at the extreme levels only. These keyers can be used, in conjunction with a keying adapter, for F4 transmission of facsimile signals. The keying adapter transforms the modulated 1800-cps facsimile transmitter output into a direct current of varying voltage. This voltage is applied to the keyer input for further handling in the same manner as F1 signals. If satisfactory F4 transmission is not obtained during initial operation, the technician should first verify that the equipment used is compatible and that the correct switch and dial settings have been made.

Use the appropriate steps from among those following to identify and correct any malfunctions found in keyer equipments. It is assumed that all indicators (panel lamps and meters) are functioning correctly.

Step	Indication	Action
a.	Equipment not energized when POWER ON indicator lamps do not light	Inspect and if necessary, repair power cord and plug. Inspect fuses and replace any blown. Verify that power is present in line. If equipment is still inoperative, follow the procedures in paragraph 1-3, POWER SUPPLIES

Step	Indication	Action
b.	POWER indicator lamp lights but PLATE indicator does not, nor does PLATE CURRENT meter deflect	Inspect the plate fuse and replace it if blown. Follow the troubleshooting procedures in paragraph 1-3, POWER SUPPLIES
c.	Equipment has no or low R-F output:	Verify that control settings are correct
	1. If malfunction exists only when R-F input used	Test complete operation of keyer. Inspect the input selector switch for condition, action, and adjustment; inspect all connections. Test for presence of R-F input
	2. If needed R-F input is supplied	Troubleshoot R-F source and connectors
	3. No or low R-F output	Test or test-substitute the R-F output tube. Test or test-substitute the oscillator tube. Test all tubes in the equipment and replace those having internal short circuits or low transconductance. Use an oscilloscope of suitable frequency characteristics to trace the R-F signal from the oscillator (or R-F input) to the output stage. Use tube socket voltage and resistance measurements at the stage where the signal is lost in order to locate defective components; replace them
d.	Output has only one condition, either SPACE or MARK	Determine if both MARK and SPACE levels are present in the input signal, using a calibrated d-c oscilloscope. (Sweep speed used is not critical, since only the presentation of two parallel lines is essential.) Verify that keyer is set for the type of signal (neutral or polar) supplied
	Input has only one signal level	Troubleshoot the signal source, local loop power supply, and local loop continuity
	Both MARK and SPACE levels present in signal but only one frequency present in output	Test or test-substitute the following tubes: pulse limiters, amplifiers, reactance tubes, and output tubes. Use the oscilloscope to trace the input signal to where keying or the R-F is lost

ORIGINAL

Step	Indication	Action
e.	Frequency shift is too wide or narrow	Verify that MULTIPLIER or XMTR MULT FACTOR switch indicates the frequency multiplication occurring in the transmitter. Verify that the FREQ SHIFT or DEVIATION setting is correct. Use a frequency meter (LM-series or equivalent) or frequency shift monitor (such as the OCT-2,-3) to measure the radio frequencies at the MARK and SPACE conditions.
	Deviation obtained does not conform to dial scale indication	Calibrate the DEVIATION control, using procedures given in the Corrective Maintenance section of the equipment technical manual
f.	R-F output drifts from original setting	Verify that equipment POWER is kept ON at all times so equipment can be energized immediately by operating PLATE switch to ON. Verify that the oven is at the correct temperature (60° or 70°C. for some equipments, correct value given in the technical manual) and that OVEN indicator lamp cycles on and off properly
	Thermometer indicates incorrect oven temperature	Adjust oven thermostat contacts according to directions in the technical manual. Replace any oven-heating resistors found defective
	Thermometer indicates oven temperature variation	Inspect condition of thermostat contacts; use burnisher to smooth contact surfaces if necessary
g.	R-F output frequency incorrect:	Verify that the 200-kc signal is correct; if not, adjust the 200-kc oscillator
1.	If external R-F source used	Troubleshoot the external R-F Source
2.	If keyer crystals are used	Measure crystal oscillator output frequencies. (Each should be 200 kc below the desired R-F output frequency.) If these steps are not effective, follow the appropriate steps in paragraph 1-6, R-F OSCILLATOR OR FREQUENCY SOURCE MALFUNCTIONS

Step	Indication	Action
------	------------	--------

TELETYPE CONVERTERS.

A teletype signal at the output of a communications receiver is composed of coded pulses of two audio frequencies. In order to control the teletype receiver, the pulses must operate a device which keys the current in a local teletype loop, either mechanically or electronically. Such a device is called a converter.

In many cases, either space-diversity or frequency-diversity reception is used at least part of the time to insure reliable communication. Such a setup requires two receivers and therefore two converters, with a comparator to select the best signal from the two available at each instant. Because of their close association, the comparator and the two converters are usually supplied together as a frequency-shift converter-comparator group.

Each of the following steps gives instructions for identifying the cause of a specified type of malfunction in converters and comparators. Use the steps appropriate to the equipment affected and the symptoms noted. Steps a. and b. are for power supply malfunctions, step c. is for determining the location and extent of malfunctions, and the remaining steps are for troubleshooting specific symptoms. It is assumed that all indicators are functioning correctly (panel lamps not burned out, for instance).

Step	Indication	Action
a.	A converter or the comparator cannot be energized and neither power indicator nor tubes light up	Verify that the POWER switch is ON. Check the fuses (with chassis withdrawn) of the malfunctioning unit. Inspect condition of power cable and connectors, from power line to the comparator if the comparator or all three units are inoperative, or from the comparator chassis to the affected converter. Check the input voltage compensation connections (under chassis and adjacent to the power transformer). Verify that primary power is present at the transformer
	If primary power is not present at transformer	Check continuity of primary power leads from transformer through switch to power input.
	If primary power is present at transformer but equipment is inoperative	Check the cable filter for continuity. Make voltage measurements and compare with last POMSEE measurements made. Follow troubleshooting procedures in paragraph 1-3, POWER SUPPLIES

Step	Indication	Action	Step	Indication	Action
b.	Inoperative converter or comparator; tubes light up but power indicator does not	Test or test-substitute the power rectifier. Measure B-plus voltage at both sides of choke and check B-plus circuit continuity. Use appropriate steps in paragraph 1-3, POWER SUPPLIES			discriminator subunit. Switches and sealed filter units are possible causes of malfunctions
c.	Comparator output absent or impaired when SELECTOR at COMBINED setting	Check all switch and dial settings. Monitor output when SELECTOR switched to CHANNEL A and CHANNEL B setting	e.	Audio input is absent at PHONES jack of converter	Test tubes of oscillator-keyer subunit. Return good tubes to their original sockets. Use tube socket voltage and resistance measurements and, if necessary, signal tracing with an oscilloscope to localize defective components
	Either (or both) CHANNEL A or CHANNEL B inputs to comparator unsatisfactory	Retune receiver to the channel received unsatisfactorily, using input meter indications for tuning and converter monitor oscilloscope indication for BFO setting. Check converter adjustments	f.	Teletypewriter (with own loop supply) fails to print clear copy when plugged into TTY jack of converter. (Note: diversity output may be unimpaired meanwhile)	Test or test-substitute keyer, trigger, and electronic-relay tubes of oscillator-keyer subunit. If this does not correct malfunction, measure tube socket voltages and resistances to locate defective components and replace any found. If necessary, trace (using oscilloscope) the TTY signal through the subunit and check continuity through connectors to front and rear-panel TTY outputs
	Either (or both channel receivers cannot be tuned for acceptable signal	Check receiver output with headset and with VTVM for amplitude. Compare with previous POMSEE readings. If receiver is malfunctioning, use steps in paragraph 1-7, RECEIVERS	g.	Comparator does not permit associated teletypewriters to print clear copy, although either converter output will do so	Verify that both converter signals are present at the comparator SELECTOR switch. If either signal is not present, use an oscilloscope to trace it from its DIVERSITY input at the rear apron to the SELECTOR switch. The malfunction may be found to be due to poor connections at the cable-filter assembly, contacts at the SELECTOR switch, or connections at any of the intervening connectors.
	Either converter has an unacceptable output, as indicated by the monitor oscilloscope indication or the output	Use a headset and VTVM to sample the converter input; signal trace any audio lines and switches involved if the receiver output is not present at the converter. If it is present, use the appropriate converter troubleshooting steps, d. through f.			When both CHANNEL A and Channel B signals are obtained at the SELECTOR switch, monitor the comparator output while turning the SELECTOR to the CHANNEL A, COMBINED, and CHANNEL B positions successively
	Both inputs to comparator acceptable but comparator output is absent or impaired	Verify that cables and connectors involved are in good condition; then follow instructions of steps g. through j. for troubleshooting the comparator		Comparator output is obtained at either CHANNEL but not at COMBINED	Inspect SELECTOR switch for dirty contacts, poor adjustment, and poor switching action. Clean, adjust, or replace as required
d.	Converter output absent or impaired, as indicated by monitor oscilloscope	Test all tubes or transistors in the converter discriminator subunit. Tubes having acceptable transconductance values and no internal short circuits should be returned to their original sockets. Transistors may be tested by most transistor testers without being removed. Replace defective tubes or transistors. Use an oscilloscope and a signal generator to trace the signal from the cable filter assembly input through the			

ORIGINAL

Step	Indication	Action
h.	Both channel signals present at selector subunit, but comparator does not have satisfactory output	Test all tubes or transistors of selector subunit and return acceptable ones to their original sockets. Use the oscilloscope to trace the signal and determine its level, starting at SELECTOR switch
	Signal not present at keyer stage input	Make voltage and resistance measurements at bases of selector diodes, axis-restorer diodes, and axis-restorer amplifier. Trace voltage changes through these stages with SPACE-to-MARK and MARK-to-SPACE level changes. (Reception of slow tape-fed dots, R, or Y will facilitate evaluation of the performance of these stages.) Replace any defective components which cause incorrect values or conditions. Use an oscilloscope for further signal tracing as far as the grids of the electronic relay tubes or transistors. Make voltage and resistance measurements at the sockets in this circuitry if desired
1.	Teletype signal present at grids of comparator electronic relay tubes but not at comparator TTYP output	Check all circuitry and connections between the electronic relay tube plates and the TTYP output filter in the cable-filter assembly. Compare the filter's measured and specified ohmic resistance; test-substitute a new filter for the original if it is suspected to be defective. Note that plate voltage for the relay tubes is supplied by the external teletype loop. Unit operation cannot be tested in use unless the positive side of the loop supply is applied to terminal A of the TTYP OUTPUT connector. The negative side of the supply will then be to the converter-comparator ground through the teletype equipment plugged into the local loop

j.	Keyed audio signal not present at PHONES and TONE OUTPUT jacks	Test the oscillator-amplifier, phase-splitter, and tone-modulator tubes; return acceptable tubes to their original sockets. Replace defective tubes. Use an oscilloscope with sweep set to a submultiple of the AF for troubleshooting audio section malfunctions. Apply the probe to successive grids in an order progression following the first oscillator-amplifier plate. Check and correct the reason for any unexpected signal loss. Test connector continuity and winding continuity of the TONE OUTPUT transformer in the cable filter assembly.
----	--	---

FACSIMILE TRANSCIEVER TROUBLESHOOTING.

Facsimile equipment in use by the Navy consists mostly of Facsimile Transceiver TT-41B/TXC-1B, associated Rectifier Power Unit PP-86D/TXC-1 and terminal equipment, and some related models of each. This transceiver with its power supply is capable of nonsimultaneous transmission and reception of graphic material. In reception, the copy is reproduced either directly (by a stylus on Teledeltos or reproducing paper) or photographically (positive or negative).

No additional equipment is needed for short-haul wire transmission of the amplitude-modulated 1800-cps facsimile output signal. Conventional A-M communication equipment can be used for its transmission by A3 emissions, but this method is subject to deterioration of reproduction with signal fading. Conventional teletype transmission terminal equipment, with the addition of Keyer Adapter KY-44()/FX and Frequency Shift Converter CV-172/U, permits frequency-shift transmission (F1) of facsimile signals. Sub-carrier frequency-shift (SCFS, A3 emission) transmission requires the use of Modulator, Radio MD-168/UX before the phone modulator of an A3 transmitter. The receiving equipment is the same as for F4 transmission, except that the BFO is not used and hence imposes no stability problem.

No troubleshooting data on the terminal equipment associated with the facsimile transceiver is given, because of the variety and few applications of such equipment. The following troubleshooting procedure is for Facsimile Transceiver TT-41B/TXB-1B; the steps given are for identifying specific malfunctions, the corrective measures are obvious in most cases. More detailed maintenance information is available in NAVSHIPS 91068A, technical manual for Facsimile Transceiver TT-41B/TXC-1B. Additional maintenance information can be found in the Maintenance Standards Books, NAVSHIPS 91068.42.

Step	Indication	Action
a.	Equipment entirely inoperative	Check switch settings. Verify that power plug and cord are in good condition. Inspect main power fuses (5 amp.)
b.	Motor fails to turn, but indicator lamps light when equipment is switched on	Inspect motor fuse. Test motor output amplifier tubes V5 and V6. Inspect and test motor for binding bearings, loose bearings, or rotor striking field laminations. Inspect mechanism for binding. Test motor windings for open circuits. Measure B-plus voltage. Verify that phase magnet and switch (used in starting motor) are operating correctly
c.	Motor fails to sync and copy is skewed	Verify that regulated B-plus has the correct value. Test-operate the equipment with the receiver set to WWV transmissions if WWV has been selected as the standard. Other-wise, set to the transmission selected as the frequency standard. Follow the instructions given for determining and adjusting motor speed in section 7-8 of NAVSHIPS 91068A, Facsimile Transceiver TT-41B/TXC-1B
d.	Exciter lamp not lit, low, or flickering	Check lamp continuity (if out entirely). Inspect the lamp socket for defects. Check interchassis Jones-plug connections. Determine if power unit is operating correctly. Test tubes V17, V20, and T15 in particular
e.	No signal output, but indicator lamps and motor operate normally	Check condition of exciter lamp and phototube by testing or substitution. Test RECORD switch for continuity and sample the signal at that point. If the previous steps are ineffective, test all transceiver tubes, returning the satisfactory ones to their original sockets
f.	Low signal output in TRANSMIT position	Perform all preceding steps. Test for impedance mismatch by removing load and measuring signal on A-C scale of VTVM. Signal should be reduced to about half when

Step	Indication	Action
		load of proper impedance is connected
g.	Low contrast in transmission and reproduction material	Check exciter lamp and socket for condition. Clean optical system. Test-substitute a new phototube to determine condition of old one
h.	Low-level RECORD indication	Verify that input signal is at a satisfactory level. Perform preceding step e. Compare material recorded by the direct "stylus" method with that photorecorded. If both are defective, the malfunction lies in circuitry used for both functions. In this case, trace the signal (a fixed-level, fixed-frequency FM input) from the input to where it is lost, using a VTVM for indication if only the presence or amplitude of the signal is to be determined. Possible causes are low input and poor condition
i.	Recorded material is uniformly skewed	Measure fork oscillator frequency. Perform step c.
j.	Recorded material has line content (may be wavy)	Remove receiver antenna and shunt terminals with 300-ohm resistor. Local system pickup is responsible if lines are still present. Verify that shielded cable is used for all connecting links and that all are in good condition. Shunt grids or terminals with a 0.01-ufd capacitor in systematic progression until line signal disappears from headset or oscilloscope used for monitoring. Determine condition of components in area those identified as possible causes of the malfunction; use tube socket voltage and resistance measurements if necessary.
k.	Random dark and light streaks in recorded copy	Check regulated power supply output. Check condition of recording lamp if photorecording. Determine condition of lead screws

Step	Indication	Action
l.	Recorded copy characterized by tone reversal and fuzziness	Adjust contrast. Verify that both transmitted and recorded copies are wrapped tightly around drums. Check optical systems of transmitting and recording equipments for cleanliness and focus; clean and focus if necessary
m.	Defective contrast in recorded copy	Verify that contrast is set correctly. Verify that neither paper nor developer is from expired, outdated stock. Verify that the developer is not too cold
n.	Recorded copy too light	Repeat preceding step m. In addition, verify that the recording lamp and socket are in good condition if photo-recording is used.

TELETYPE PANEL.

Teletype equipment is usually connected to a transfer and metering panel, rather than directly to its associated terminal equipment. This permits the greatest possible versatility in equipment usage and also facilitates substitution in the event of equipment failure.

Teletype Panel TT-23/SG is commonly used in small and shipboard installations to provide for patching up to 12 teletype and test equipments to as many as 6 terminal equipments. It also permits control and metering of the current in each of the six loops. This equipment is relatively troublefree, but an outline of troubleshooting procedures is given following in the event difficulty is encountered. Although intended for Teletype Panel TT-23/SG, it is applicable to others as well.

Step	Indication	Action
a.	No LOC. CUR.—powered loops operate or have current indication.	Use voltmeter to determine if loop power is present at the panel at all.
	No loop power present at panel.	Check output of and connections to the associated power supply; follow the procedures given in paragraph 1-3, POWER SUPPLIES, if power is absent.
	Loop power present	Test continuity of panel power wiring from power input to terminals of LOC. CUR./EXT.CUR. switches

Step	Indication	Action
b.	Loop power present but all loops are inoperative and indicate an incorrect current or no current	Open panel and inspect all connections and the condition and operation of the loop selector switch. Repair any defective or questionable connections found and clean, adjust, or replace the switch if necessary
c.	Loop power present, but meter indication incorrect or absent for all loops, whether or not operative; step b. has been performed	Measure the resistance of the meter calibration resistor and replace it if incorrect (900 ohms $\pm 1\%$ for Teletype Panel TT-23/SG)
d.	Loop power present and loops operating, but no current indicated for any loop	Adjust LINE CURRENT control for correct voltage (0.6V DC for 60-ma loops) across the 10-ohm meter shunt resistor of a LOC. CUR. loop selected by the loop selector switch. Measure the voltage across the meter calibration resistor. Now measure the voltage across the meter
	Full voltage measured across meter, none across calibration resistor.	Meter is open; replace it
	Full voltage measured across calibration resistor, none across meter	Check meter to find if it is shortcircuited; if so replace it
e.	One loop inoperative when switched to LOC. CUR. supply (checked with all plugs removed from loop)	Perform preceding step b. for malfunctioning loop. Determine condition of current-limiting resistor (R104) for malfunctioning loop. Determine condition of meter shunt resistor (R102) for malfunctioning loop
f.	One loop fails to operate or give indication of current flow.	Remove all plugs from loop jacks. If loop is still inoperative, check continuity through terminal and teletype equipment wired into loop.
	Loop is operative with all plugs removed.	Plug one equipment at a time into looping jacks of malfunctioning loop until operation fails and no current is indicated. Identify plug which stops when inserted.

Step	Indication	Action
	Open-circuited equipment or plug identified.	Verify that equipment or plug is defective by substituting it for a similar, operative equipment.
	Open-circuited condition identified and verified.	Inspect condition of plug, leads, and connections; repair or replace any found defective. Test teletype equipment for open circuit and correct it if found.
	Suspected equipment and plug operate when inserted in another jack or loop	Inspect malfunctioning jack for poor connections, dirty or pitted contact surfaces, and incorrect mechanical action
g.	One loop fails to operate or give indication of current flow when a plug (dummy or connected to equipment) is inserted in loop SET jack	Inspect condition and operation of SET jack. Clean contact surfaces, resolder poor connections, and adjust spring members as required for correct operation. Leads from loop should be disconnected from wired-in teletype equipment (3-series and 4-series terminals) and shorted when plug is inserted in SET jack. Inserted plug should then make connection with the teletype equipment wired to the 3-series and 4-series pair of terminals

SERVICE NOTES COMMUNICATIONS

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS

WHAT DOES ANTENNA CURRENT MEAN?

"Meter inoperative, evidently burnt out. 0-5 ampere range seems too low. We find it difficult to keep antenna current this low on most frequencies. USS ____." This report is made frequently. Here is another typical report. "...by changing the length of the antenna, the current was raised from 1 ampere to 2 amperes, thereby increasing our field strength...." This statement is incorrect. The operator merely moved the standing wave relative to the ammeter to bring a high-current part of the standing wave on to the ammeter. The field strength did not necessarily change, and the operator had to record new adjustment settings for his loading circuit due to the altered input impedance of the antenna. It is believed that the following short discussion will prove helpful to the understanding of the distribution of current in an antenna system.

Figure 1 shows an antenna system with the parts drawn stretched out in a line. Figure 2 shows a standing wave of current of an antenna system. The shape of the loops is supposed to be sinusoidal, but these curves will suffice for discussion purposes. Length in the horizontal direction means "distance along a wire". Height in the vertical direction means "quantity of current in the wire". The curves show the amount of current at any point in the wire. The current in a standing wave is not the same all along the wire, but varies as shown in figure 2. There are several ways to draw a standing wave, but the one shown is one of the best because it shows all current as positive, or above the zero line, which is the only way a thermocouple-ammeter can indicate it. In practice, the standing wave is not as smooth as shown, but is partly irregular due to changes in surge impedance along the length of the antenna system.



FIGURE 1.--An antenna system



FIGURE 2.--A standing wave of current

Consider a standing wave for a frequency of two megacycles. Its half-wavelength is computed by dividing the frequency in megacycles into 492 feet. The answer in this example is 246 feet which means that there will be 246 feet between the nulls or zero-points of the standing wave (see fig. 3). This distance between nulls is called a half-wavelength. Notice that all points separated by a half-wavelength have the same amount of current in them.

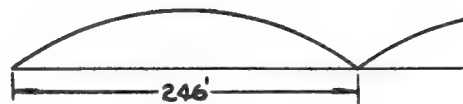


FIGURE 3.--A half-wave at two megacycles

Figure 4 shows how much current the ammeter will indicate for various combinations of antenna length and standing wave. The antenna's length is fixed aboard ship, but the standing wave's length varies with the frequency as described above. Each example has a note beside it giving an estimate of the current. The antennas are drawn spread out like the one in figure 1. Actually each antenna can be of any length, and each standing wave can be of any frequency, provided the standing wave and antenna fit each other as shown in the figure.

The conditions shown in figure 4 will occur when the ammeter is connected between the antenna and the loading reactors of the transmitter—which is usually the connection used. In a very few cases, the transmitter utilizes a different connection, with the ammeter in the loading circuit, and then the readings depend on the tuning as well as the antenna lengths.

The most useful services that the ammeter can perform are:

(1) On frequencies for which the antenna current happens to be large enough at the location of the ammeter to indicate some current, one can be sure that modulation is occurring by watching the ammeter move during speech or mcw transmissions. The meter usually moves slowly and reads only 22.5 percent extra current during 100 percent modulation. (A superior modulation indicator would be a monitor built for the purpose, with which an oscilloscope or headphone indication is used.)

(2) If the ammeter indicates a readable current, then it can be used as a carrier indicator because the current reading will drop if the carrier fails. However, this function is not important as the final plate ammeter and other meters will indicate the same thing. Another excellent carrier indicator consists of a neon bulb loosely coupled to the antenna. This also makes a satisfactory modulation checker.

(3) If the ammeter current is readable and if the antenna (or dummy antenna) input resistance is known, then the power output of the antenna may be computed. In general, the technician does not know the antenna resistance.

(4) If the ammeter current is readable it can be used as a guide for further tuning of any stage in the transmitter. However, the transmitter is usually equipped with other meters for tuning the transmitter correctly.

(5) The antenna ammeter is useful for the indication of accidental changes in the transmitter output or in the antenna impedance (due to grounds, etc.) provided that the correct reading for the frequency in use is recorded and checked frequently. This action is also equally well accomplished by observing the final plate ammeter.

Meter reads **ZERO** (Half-wave-length antenna)



Meter reads **LOW** (Antenna very short compared to wavelength in use)



Meter reads **ZERO** (Antenna equal to wavelength or any whole number of half-wavelengths)



Meter reads **VERY HIGH**, and may *burn out*. (Antenna length is an odd number of quarter-wavelengths)



Meter reads **several amperes** (Antenna length is not any of the above cases)



FIGURE 4.--Ammeter readings for various combinations of antennas and frequencies

(6) The antenna ammeter is often useful when reducing the output power, since reducing the antenna current to half its normal value will reduce the radiated power to one quarter its normal value.

It should now be evident that the antenna current meter is useful, but not a necessity, and that in a given installation it can indicate any current from zero to off-scale, the value depending on the frequency as well as on the amount of power fed to the antenna.

What to do when the frequency in use is such that the antenna ammeter indicates zero: **NOTHING!!** Proper use of the *final plate ammeter* will indicate that power is being fed to the antenna.

What to do when the antenna ammeter is being driven off scale: Try to take action, because the meter may burn out and prevent transmissions until a repair is effected. You may reduce the transmitter power by decreasing the *power fed to the transmitter*.

CONSTRUCTION OF A STANDARD DUMMY ANTENNA

In aligning certain model receivers, such as the RBB/RBC, the instruction book specifies that the signal generator shall be connected to the antenna terminal of the receiver through a standard dummy antenna. This insures that the input circuit of the receiver will function in a

normal manner without detuning, etc. (in the RBB/RBC equipments care should be taken that the antenna transfer links are connected in the *antenna* position while aligning).

The standard dummy antenna is made in accordance with specifications laid down by the Institute of Radio Engineers Standards Committee on Radio Receivers. It is furnished as a part of the model LP standard signal generator, but for the information of those who do not have the model LP at hand and wish to construct a standard dummy antenna, the following information is supplied.

The standard dummy antenna is a network of lumped impedances which closely approximates the electrical properties of a standard antenna over a wide frequency range. A standard antenna is defined by the Institute of Radio Engineers booklet "Standards on Radio Receivers, 1938" as "an open single wire antenna (including the lead-in wire) having an effective height of 4 meters and having, at frequencies between 540 and 1600 kilocycles, substantially the same impedance as a series circuit containing a capacitance of 200 micromicrofarads, a self-inductance of 20 microhenries and a resistance of 25 ohms. Its fundamental frequency is approximately 2500 kilocycles. Its characteristic resistance is approximately 550 ohms, and its geometric mean impedance in the frequency range of

its harmonic frequencies is approximately 400 ohms resistance."

The elements of the standard dummy antenna are condensers (C1 and C2) of 200 and 400 micromicrofarads respectively, an inductor (L) of 20 microhenries, and a resistor (R) of 400 ohms connected as shown in Figure 1. Page 1-4. No physical arrangement is shown as the many types of jacks and fittings on various signal generators preclude a universal layout. It should wherever possible be made compactly and be enclosed in a metallic case which should be grounded. The parts should be so arranged that the capacity between any two points is as small as practicable. The effective values of all components should be within 10 percent of the nominal values. Winding data for the inductor (L) of 20 microhenries inductance is given in the curves of Figure 1.

When in use, the dummy antenna is connected between the "high" side of the signal generator and the "antenna" post of the receiver. The "low" side of the signal generator is connected to the chassis of the receiver and to ground.

CONNECTING CABLES TO "AN" CONNECTORS

Specification 15C1 (INT) for Cables, Electric, Insulated, Shipboard Use, page 28, states, "In the case of cables having more than one layer of conductors, the numbering ...shall be from the innermost to the outermost; i.e., the number one conductor shall be the center conductor." AN cable connectors have prongs designated by the letters, A, B, C, etc., starting at the outside circle of prongs and working towards the center. If wire number one is connected to prong A, etc., obviously, transitions or cross-overs will have to be made to permit connection of all wires. The result will be as shown in Figure 1.

There is no Navy requirement that the number one conductor be connected to the A pin, number two conductor to B pin, etc. It is therefore recommended that whenever possible the cables be connected with the inside conductors to the inside pins and the outside conductors to the outside pins. The result, as shown in Figure 2, will be a neater, more workmanlike connector, requiring less time and effort to make the connections, and having less danger of shorts or grounds from chafed insulation.

RECEIVING ANTENNAS

Numerous activities report from time to time that steel stays are employed as receiving antennas on certain classes of vessels. Several years ago this practice was

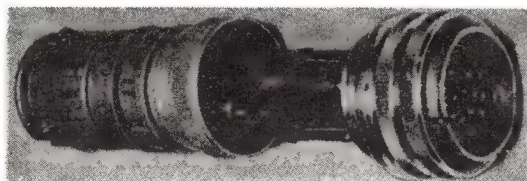


FIGURE 1.--Connector with wire cross-overs

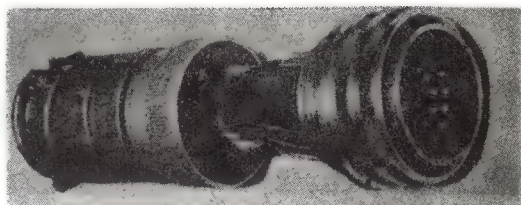


FIGURE 2.--Connector without wire cross-overs

considered generally acceptable but recent experience definitely indicates that rigging makes an unreliable antenna. As a result of these experiences, the policy of the Bureau in regard to antenna practice has been changed and rigging is not to be used for receiving antennas regardless of circumstances or conditions.

FAILURE OF TRANSMITTER TO LOAD

When a transmitter fails to load properly, check the antenna system for open or poor contact at the feed-through insulators. A simple trunk continuity can be made by connecting with a jumper the antenna wire to the ship's hull outside the external feed-through insulator. Then disconnect the antenna from the transmitter and check the d-c resistance from antenna bus to ground. Zero resistance indicates satisfactory continuity.

Be sure to remove the jumper after the test!

ANTENNA TRUNKS

The current general requirements for Radio Antenna Systems, Bureau of Ships Specification RE 66A 430B is being revised to specify that transmitter antenna trunks shall be fabricated of 0.094 in. steel having a copper cladding of 0.008 in. on one side (inside) only. It is recommended that orders be made up of items 946 or 947, as these larger sizes are more economical and will limit the number of items to be carried in stock.

When copper-clad steel is not available, 61 ST 6 aluminum serves as a substitute. In general, aluminum should be used only for special installations: i.e., in minecraft where the magnetic signature must be kept low.

ANTENNA DISCONNECT SWITCHES

It is suggested that, when any bar type antenna disconnect switch (Drawing RE 66F 311) presently installed in many 9" x 11" radio transmitting antenna trunks in Navy vessels is in need of repair, it be replaced by the installation of a Type 24270 antenna switch as an alteration equivalent to repair.

The Type 24270 antenna disconnect switch is essentially a section of a 9" x 11" transmitting antenna trunk containing a single-pole three-position switch and a blanking off plate. It has been tested and approved by NRL, Anacostia, D. C., and is obtainable through ESO, Great Lakes.

ANTENNA WIRE FOR SHORE USE

In order to provide a suitable light-weight antenna wire

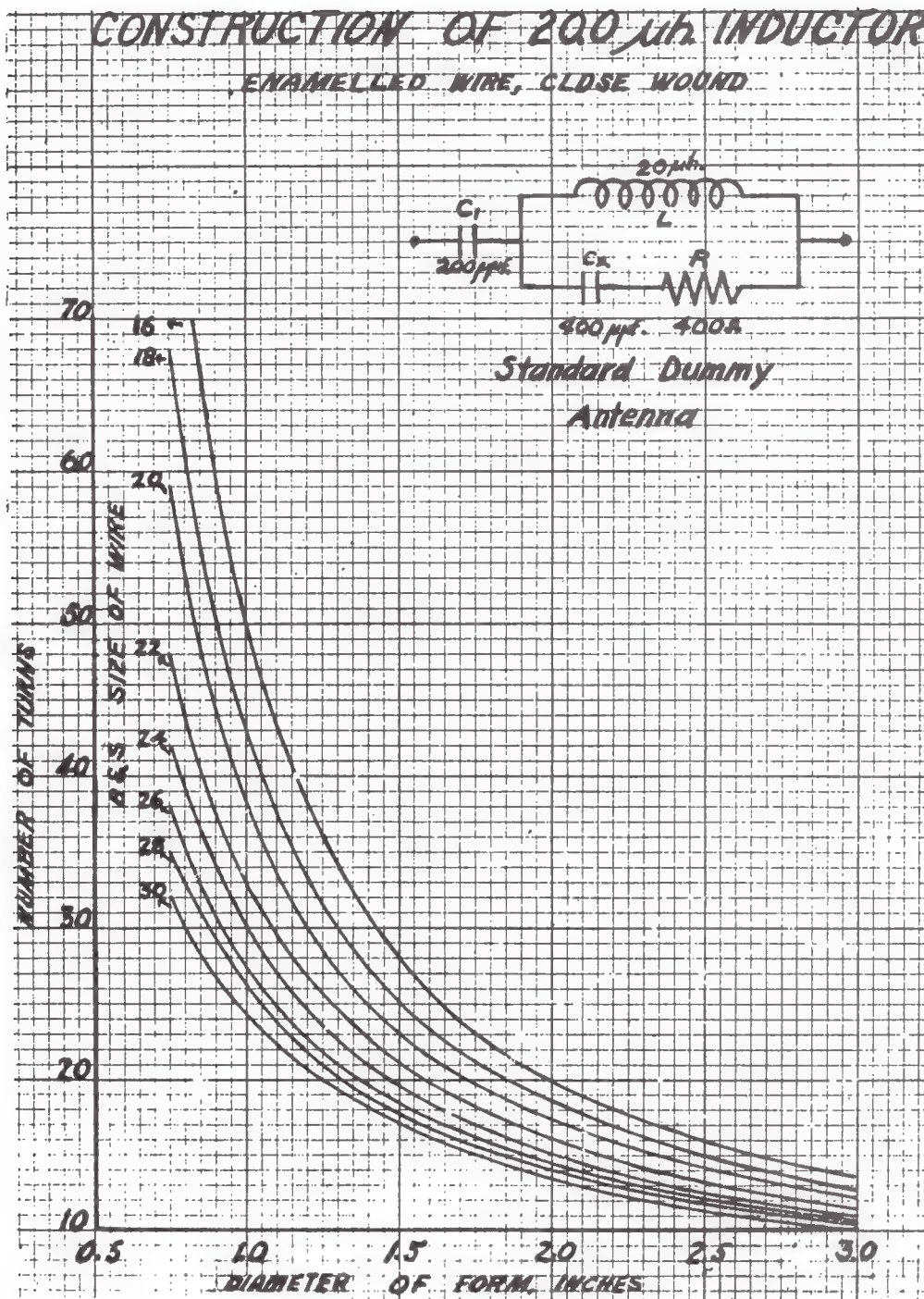


FIGURE 1.--Data for constructing a dummy antenna

of high tensile strength for shore and advanced base use, the Bureau of Ships has initiated a procurement to establish a stock at Navy Yard, Mare Island and Navy Yard, New York of the following wire:

AWG	Mare Island coils	New York coils	Approx. feet per coil
No. 10	60	40	3471
No. 12	60	40	5518
No. 14	60	40	8771
No. 8 (3 strands No. 14)	60	40	2900

This wire has been procured under Contract No. NXsr-55627 from the Copperweld Steel Company. The first 40 percent of the solid No. 10, No. 12, and No. 14 wire will be bare, in 100-pounds coils; the remaining 60 percent will be enameled wire on returnable reels holding the same amount of wire. Navy Yard, New York and Navy Yard, Mare Island are expected to maintain an adequate stock of this wire in the future to meet the needs of advanced bases and shore activities.

BOWL INSULATORS

Caution must be exercised in tightening metal hardware on bowl insulators. One instance of damage to insulator bowls occurred when the hardware was tightened in a tropical climate causing excessive stress on the insulator when the ship reached a cold climate. Obviously temperature expansions and contractions must be considered when installing glass or ceramic material insulators.

PROPER TREATMENT OF RADIO ANTENNA SYSTEMS

Paint, varnish, shellac, grease or any other form of coating *shall not* be applied to any portion of ceramic or phenolic insulating materials forming a part of any radio antenna system.

IDENTIFICATION OF RECEIVING ANTENNAS

A nameplate on antenna transfer panels will make readily available to shipboard personnel the useful frequency range of any installed receiving antenna.

In accomplishing this, it is recommended that a nameplate approximately one-half (½) inch by one and one-half (1½) inches be attached to each antenna terminal on an antenna transfer panel. The antenna designation and the length of the antenna in feet will be inscribed on this nameplate; for example, RA-61 over "52 feet". A second nameplate on which the useful frequency range of the antenna is inscribed, for example, 2-7 m.c., will be fastened adjacent to each antenna. If the useful frequency range is not known, the second plate should be of a material suitable for the ship personnel to record the useful frequency range of each antenna as it is ascertained from actual use of the antenna.

CONNECTION OF RECORD PLAYERS TO SHIPBOARD BROADCAST RECEPTION SYSTEMS

The Bureau of Personnel is procuring and furnishing to the Service a number of portable (suitcase type) record

players for training and entertaining purposes. These units are primarily for shore-based personnel, but a number of them are finding their way aboard vessels of the fleets. Once aboard a vessel it is natural that they be utilized in a manner whereby they will serve the greatest number of personnel; this immediately dictates that the output of the record players be connected to the vessel's radio broadcast distribution system. This is entirely permissible and feasible due to the fact that from two to four spare channels were provided in the original design of the distribution system just for such anticipated purpose. However, the two types of record players being distributed by BuPers at the present time were not designed with this particular use in mind and, therefore, are not provided with exactly the proper output circuit for coupling into one of the broadcast distribution channels. This fact has resulted in a number of unsatisfactory lashups, and in an attempt to improve conditions, inexperienced personnel will unnecessarily modify or mutilate either the record players or the distribution system or both. On the other hand, if the very simple interconnections between the record player units and distribution channels are accomplished as indicated herein, the results will be very satisfactory and the normal functions of neither the phono units nor the broadcast system will be adversely affected.

The two record player units being furnished by BuPers are identified as Sandwich model MC-364 and Birch "Flagship" model. Both units are very similar and both give excellent results. The internal wiring diagrams of both types are reproduced herein as Figures 1 and 2 respectively. Both have dual speed (33-1/3 and 78 RPM) motors and will accommodate any size or style of disc.

The interconnections between the record player and the standard shipboard model RBO broadcast distribution system should be accomplished as indicated in Figure 3. It should be noted that the connections are to be made to the low impedance output circuit of the amplifier, to which the speaker is normally connected, and not to the high impedance PHONO OUTPUT jack located on the front panel. The latter connection will not produce satisfactory results. A 4-prong plug should be used for the connections to the record player if it is desired to retain the portability feature of the unit; otherwise, the connections can be made internally in permanent manner. It is preferable to install a double throw switch adjacent to the record player unit and connect this switch in a manner that will permit instant change-over from the distribution system to the record player's speaker and vice versa. Particular note should be made of the fact that the two record player manufacturers utilize different terminals of the 4-prong connectors. The output of the Sandwich model is connected to terminals No. 1 and No. 3; whereas, the output of the Birch model utilizes terminals No. 1 and No. 4. One side of the secondary winding of the output transformer is grounded in the early models of both types of record players, as indicated in Figures 1 and 2. If this ground connection exists in any record player being connected to the RBO distribution system, it must be removed before the record player is operated with the system. The ground connection within the unit is made in such a manner that it can be

easily removed. Unless this ground is removed from the output winding, the reproduction will not be satisfactory as the completed circuit results in one-half of the center-tapped speaker-amplifier input being grounded. The Bureau understands that this ground connection has been omitted on both types of record players of recent manufacture.

Connection to the distribution system should be made to channel No. 5 in the standard 10-wire connection box located near the model RBO receivers, as indicated in Figure 3. However, if the record player unit is to be located in a space removed from the receivers, as is frequently the case, the connection may be made to the same channel (No. 5) at the terminal block in any speaker-amplifier unit along the line. If two record players are installed and connected to the RBO system, the second unit should be connected to channel No. 4.

The 10-ohm 10-watt loading resistor indicated in Figure 3 should be used in all such installations. Any resistor possessing the specified characteristics may be used in lieu of the specific type indicated in the diagram.

If "stops" have been installed on the channel selector switches of the type 49131 series speaker-amplifier units of the distribution system to blank-off spare channels, it will be necessary to remove them from all units before placing the system in operation.

Record players (either the above types or any others which may find their way aboard Naval vessels) shall not be connected to any model RBO series receiver or the associated distribution channel. A phono connection is provided in these receivers but shall not be used in shipboard installations as separate channels are provided for such purposes in the distribution system. When record players are connected through a receiver unit, it deprives personnel of the broadcast reception normally available on that particular channel.

Some operating notes for these record players are:

(1) The equipment is turned on by rotating the tone control in a clockwise direction.

(2) Volume is controlled by the control marked "Phonograph".

(3) After allowing the tubes to heat for 30-45 seconds, run the ball of the thumb gently across the point of the needle. A clicking or rasping sound indicates that the equipment is ready for operation.

(4) Ordinary commercial phonograph records are played at 78.26 RPM and the groove runs from the outside toward the center. Transcriptions are played at 33-1/3 RPM and may begin either at the inside or outside. The label on the transcription will indicate the correct starting point.

(5) Motor speed may be changed by gently moving the RPM arm from 78 to 33-1/3 or vice versa while the motor is running. CAUTION: Do not force or jam the arm or the motor will be locked with consequent damage. Never change speeds unless the motor is running.

(6) Keep the microphone control set at zero unless it is in use as considerable hum will be produced otherwise.

(7) Make sure that the needle is secure in the needle chuck. It should be tightened with thumb and forefinger only—Never with pliers or other tools. Type 36N535 steel

needles are recommended. These are available in packets of 100 for 15¢ at most recreational supply activities. If a permanent needle is used, it should never be removed or turned until it is ready for replacement.

Some maintenance notes for these record players are:

(1) The following spare parts are furnished with each unit:

Two crystal cartridges

Three fuses

One set of tubes

Five packages of needles

One pilot lamp (Birch record player only)

(2) The phonograph motor should be lubricated every 60 days. Navy oil symbol 2075 is recommended.

(3) The speed of the turntable may be adjusted by moving the lever arm marked "speed control." It should be adjusted to run at 78.26 RPM or 33-1/3 RPM and should be checked with the stroboscope and neon lamp which are supplied with the instrument. A stroboscope disc is being published in this bulletin for use in the event that the original disc becomes lost or damaged.

(4) **Important**—An Astatic type S-12 crystal pickup is supplied with the unit. Two replacement crystal cartridges are supplied as spares. Crystal microphones, headphones and phonograph pickups are easily and quickly damaged by exposure to excessive heat. Under NO circumstances should the pickup itself or the replacement cartridges be subjected to temperatures of 120° F. or above. Should there be any question of the ambient temperature exceeding this level, a thermometer should be placed alongside the pickup and if 120° F. or above is reached, immediate steps should be taken to cool the unit. Should it become necessary to replace the crystal cartridge or connecting wires, a minimum of heat should be used when soldering connections at the cartridge. Cool the joint with a swab of cotton dipped in alcohol immediately after removing the soldering iron. Heavy-handed sweating in of soldered joints at the cartridge terminals is practically certain to ruin the crystal. Quick soldering with minimum heat, a clean iron, low-melting point solder and immediate cooling of the joint is absolutely safe. Should extra crystal cartridges be required, the proper unit is Astatic type B-2 replacement cartridge.

INSTRUCTIONS FOR USING A STROBOSCOPE DISC

The stroboscope disc, Figure 1, may be used to check the speed of any phonograph recording or reproducing turntable at either 78.26 or 33-1/3 RPM, which are the correct operating speeds.

Carefully cut out the disc and mount it on stiff cardboard or on a 10-inch phonograph record using rubber cement or any other adhesive that will not shrink or stretch the paper. **Do not use ordinary paste.** Extreme care should be taken not to distort the drawing. If the disc is mounted on a phonograph record, make sure that the drawing is truly centered over the record spindle hole; if it is off center it will affect the accuracy of the stroboscope disc, resulting in a backward and forward movement of the segments even though the turntable speed may be constant. By the same token, care must be exercised in punching or

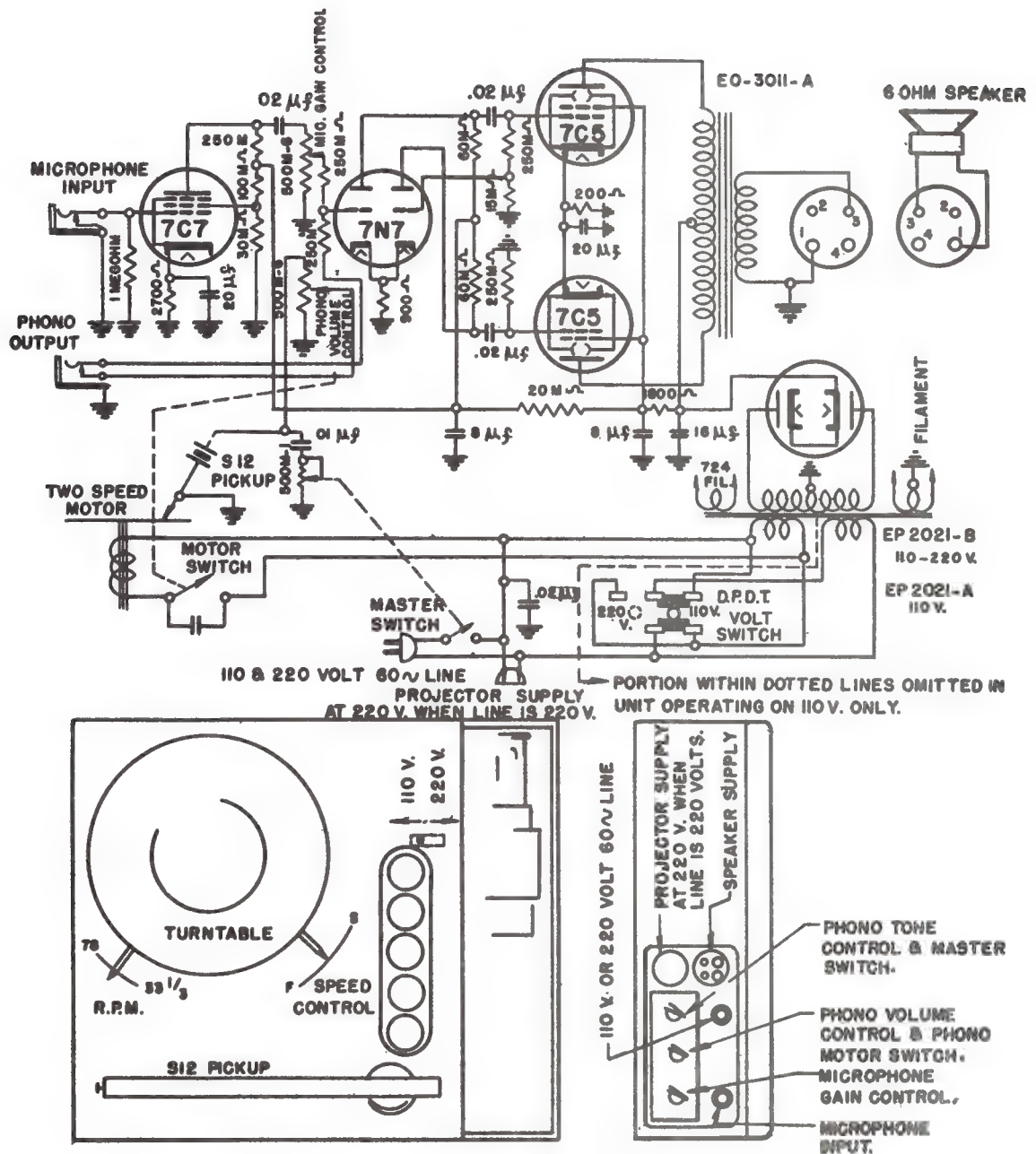


FIGURE 1.--Sandwich model MC-364 reproducing equipment.

1-SM-8

ORIGINAL

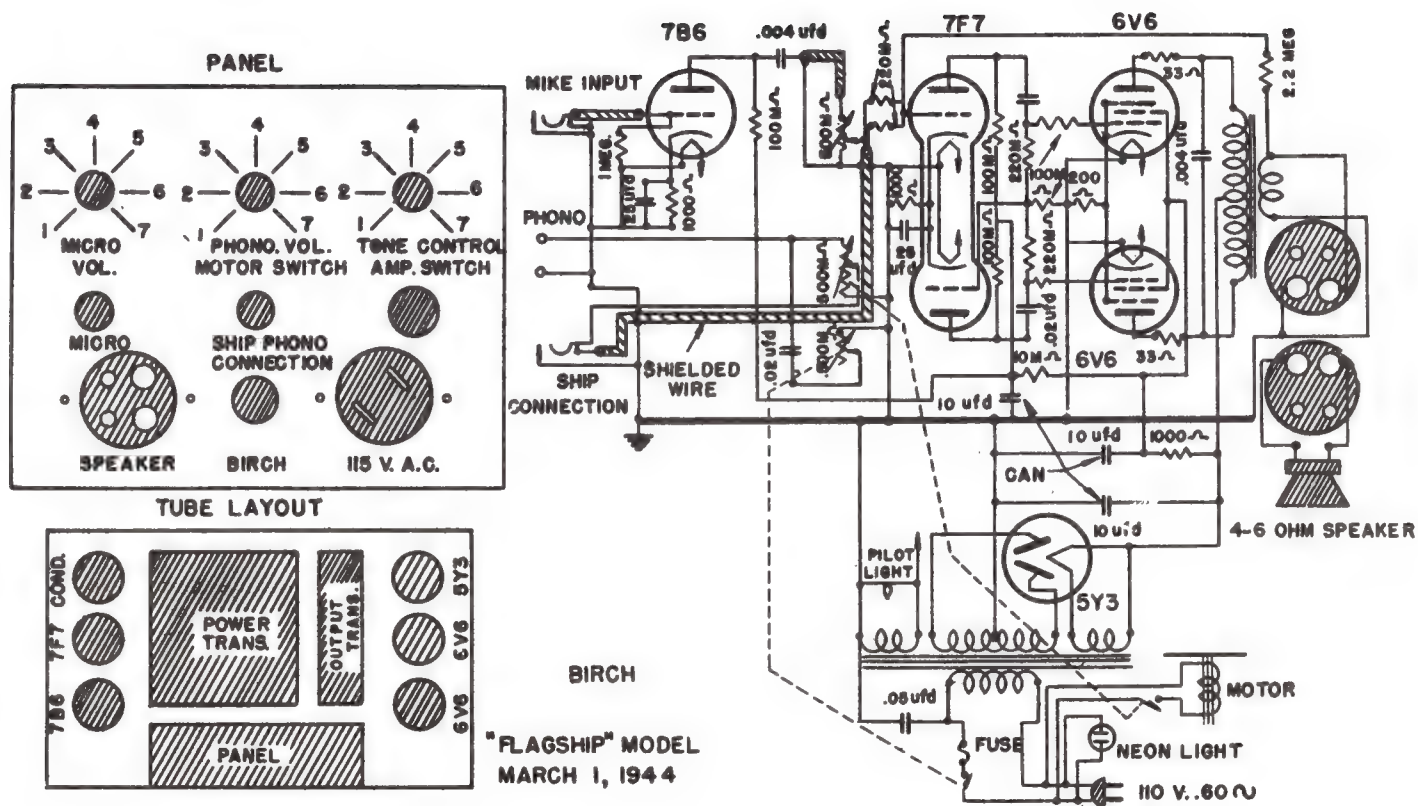
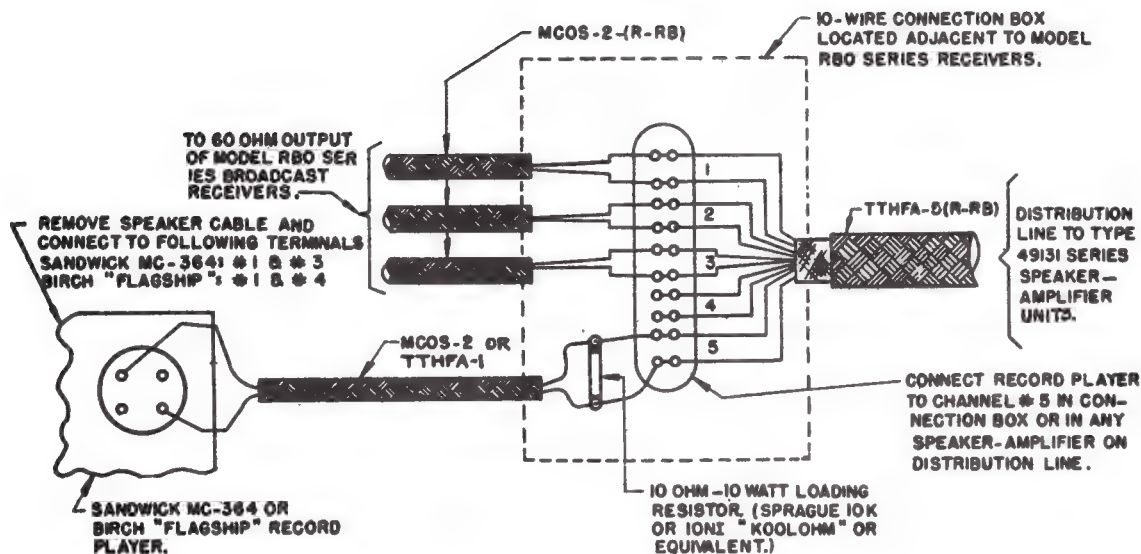


FIGURE 2. --Birch "Flagship" model reproducing equipment



WARNING: 1. DO NOT CONNECT OUTPUT OF RECORD PLAYERS TO MODEL RBO SERIES RECEIVERS.

2. DO NOT CONNECT HIGH IMPEDANCE OUTPUT OF RECORD PLAYERS TO BROADCAST SYSTEM CHANNELS.

FIGURE 3.--Connections between record players and model RBO distribution system

cutting out the center hole in the stroboscope disc. The white dot is the exact center; the small black area the part to be removed. A sharp-pointed scribe compass will do the job nicely.

With the turntable in motion and the stroboscope disc in place, cast the light from a neon lamp directly on to the rotating disc segments, shielding the disc from extraneous light. The neon lamp must be energized from a 60-cycle a-c supply. If the turntable is operating at the correct speed, one set of the segments will appear stationary—the inner set for 78.26 RPM and the outer set for 33-1/3 RPM. It should be pointed out that the accuracy of the device is dependent upon the exactness with which the frequency of the a-c supply is kept at 60 cycles per second. A backward or forward motion of the segments indicates that the turntable is running below or above the correct speed and its speed should be adjusted until the proper set of segments appear stationary.

In using the stroboscope, it is preferable to simulate actual operating conditions by checking the turntable speed with a normal load. This may be accomplished by checking the speed with the pickup traversing the outer grooves of a 10-inch record placed on the turntable underneath the stroboscope disc—or the outer grooves of the record on which the stroboscope disc is mounted as the case may be.

In an emergency an ordinary incandescent lamp may be used in lieu of a neon lamp. However, the incandescent

lamp is not nearly as satisfactory due to the thermal inertia of the filament preventing it from cooling below the temperature of incandescence during each cycle of AC. This effect causes the segments to appear blurred although their movement is easily observed. When viewed with light from a neon lamp, the segments appear sharp due to the lack of thermal inertia in a neon lamp, the light flashing off and on 120 times a second. A single fluorescent lamp operated on a 60-cycle a-c line also makes a satisfactory light source for viewing the stroboscope.

OSCILLATOR RADIATION—A SUMMARY OF SAFE AND UNSAFE RECEIVERS

The following information was compiled at the Naval Research Laboratory. It was gathered from the records of tests conducted at the laboratory. The receivers are grouped in two sections—those operating in the frequency range above, and those operating below 30 megacycles. Two columns are entered for all receivers. The first lists those frequencies which are "safe"—i.e., on which operation would present no hazard to security. The other column lists the "unsafe" frequencies—i.e., on which security would be endangered by oscillator radiation. In all cases the frequency listed is the oscillator frequency.

All receivers listed are rated in accordance with a safety limit of 400 micromicrowatts power appearing from antenna to ground at optimum load resistance.

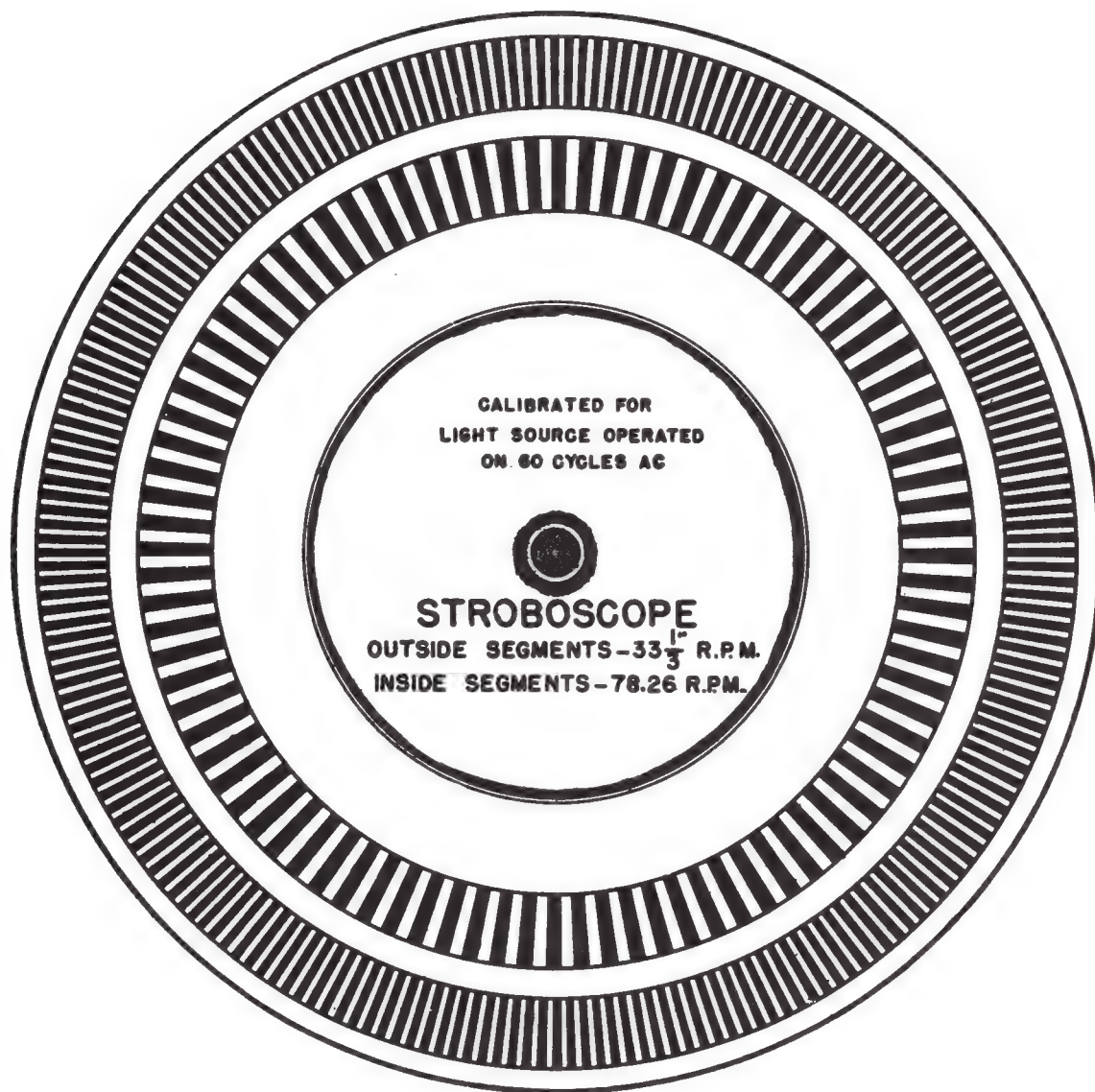


FIGURE 1.--Stroboscope disc

SERVICE NOTES

NAVSHIPS

900,000.1

COMMUNICATIONS

Low-Frequency Receivers (Below 30 mc.)

Type rcvr	Safe frequencies	Unsafe frequencies
REa	All, except with regen. max.	72-130 kc. with max. regen.
RFa	All, except with regen. max.	Above 240 kc. with max. regen.
RAB-1	Up to 23 mc.	23-38 mc.
RAC-1	All	
RAL-4	All	
RAO	All	
RAO-2	All	
RAO-3	All	
RAS	Bands 1-5	Part of band 6, Band 7.
RBA	All	
RBB	All	
RBC	All	
RBG	Band 2. Band 1 very close to limit just above at 540 and 1300 kc.	Bands 3, 4, 5.
RBH	All	
RBL	All	
RBL-3	All	
RBM (hf)	Bands 1, 2, 3, Band 4 (14-19 mc).	Band 4 (13-14 and 19-22 mc).
RBM (mf)	All	
RBO	All	
DP-9	All	
TBX-4		All.
TCS		All.
TCS (with Magnetic "wonderbox".	All	
Hallicrafter SX-28 (now RCF).		Definitely qbove 3 mc.
RMCA 8505 (now RCG).		All.
SCOTT SLR-F (now RCH).	All	
Bendix BC-348-Q.	2 lowest freq. bands	3rd band 3.5-5 mc. 4th band 6-9 mc. 5th band 9.5-13 mc. 6th band 13.5-17 mc.
Emerson 413		All.

Type rcvr	Safe frequencies	Unsafe frequencies
Farnsworth C-138	3 lowest freq. bands	3 high bands.
Hallicrafter Ht-11.		All.
Magnavox CR-155.		All.
National HRO (Bakelite ant. block).	Up to 26 mc.	Above 26 mc.
National HRO (Styrene ant. block).	2 low-freq. bands	2 high bands.
Philco 42-788T		All.
Philips 512	Up to 3 mc.	Above 3.5 mc.
Philips 513AN	Up to 18 mc.	18-22.5 mc.
Philips 595AM	Broadcast band 1-2.1 mc.	Elsewhere: 2.1-23 mc.
RCA 8506B	All.	
RCA AR88	All.	
RCA Q-33		All.
Scott SLR-C	Up to 21 mc.	Above 22 mc.
Sparton 842SX		All.
Zenith 8W 645At.		All.

High-Frequency Receivers (Above 30 mc.)

Type rcvr	Safe frequencies	Unsafe frequencies
RAQ	70-153 mc.	153-190 mc.
RBQ (with shielded crystal) ¹	Harmonics up to 126 mc.	Above 126 mc. (except 132 mc).
BL-2		All.
CBXG		All.
TBS ¹	All, if trimmers are not peaked by mistake to oscillator; then only one frequency is unsafe.	
TBY-2		All.
Hallicrafter S-27 (now RBK).		All.
Bendix BC-639-A.		All.
Communications Co. model 132. ¹	23-67, 100-120. Above 146 mc.	Harmonics below 23 mc., 90 mc., 135, 146 mc.

¹Measured on crystal harmonics.

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

Type rcvr	Safe frequencies	Unsafe frequencies
Hallcrafters NS-27-C.	108-113 mc.	113-195 mc.
RCA (rcvr. freq.: 200- 400 mc).		All.

COMMERCIAL RADIO RECEIVING EQUIPMENT ABOARD U. S. VESSELS

A number of commercial shipbuilding yards have continued to follow an old peacetime practice of presenting broadcast entertainment receivers to the crews of vessels that were built in their yards. For a number of reasons, the practice should be discouraged and Navy shipbuilding representatives at the various yards involved should take steps to insure that unauthorized receivers are not placed aboard new construction vessels.

The presence of "crew" or "individually" owned receivers on board certain vessels has recently been the subject of an unusual amount of official correspondence which should not have been necessary. In view of this correspondence, certain decisions have been necessitated which were not entirely satisfactory to all parties concerned. Therefore, the cause of such situations should be eliminated at the source.

Practically all available stocks of commercial non-radiating broadcast receivers have been exhausted and replacements are not being manufactured. Therefore, the majority of receivers being presented to vessels at the present time are of the unapproved radiating types which cannot be used while the vessels are at sea. Certain of the various methods used to secure these receivers, while at sea, are somewhat uncertain and, therefore, unsatisfactory from an overall standpoint. In view of the approved type of broadcast entertainment equipment being supplied by the Bureau as a part of each vessel's allowance, it is considered that any additional broadcast receivers are unnecessary and that the practice of placing them aboard Naval vessels should be terminated.

The following types of radio receiving equipment have been approved by the Federal Communications Commission as capable of being used and operated on board ships of the United States in accordance with the limitation regarding the radiation of energy imposed by the rules of the commission, i.e., that the electromagnetic field created does not exceed 0.1 microvolt per meter at one nautical mile from the receiver:

COMMUNICATION RECEIVERS

Manufacturer	Freq. range (kilocycles)	Type or model number
Arnessen Electric Com- pany	841LW	80-550
Federal Telephone & Radio Corp	Mackay Radio & Telegraph Co.	117-C 16-40 100-200 300-530
	128-A	16-650
	128-AX	15-650
	130-A	300-500
	138-A	80-560 1900-25000
Globe Wireless or Heintz & Kaufman	936	70-210 350-515
Hallcrafters, Inc.	SX-28A ¹	540-40000
National Company	D. C. SW-3RM	100-600
Radiation Products Corporation	R-96-SR	140-500
Radio Corporation of America	AR-88	1500-12000 535-32000
	AR-67-X	75-1500
	CR-91	75-550 1500-30000
Radiomarine Corporation of America	AR-8503	15-600
	AR-8506-A	210-550 1900-25000
Radiomarine Corporation of America	AR-8506-B	90-550 1900-25000
	AR-8507	70-515
	AR-8510	15-650
E. M. Sargent	AH-10X	34-550
E. H. Scott Radio Labs	SLR-C	80-520 3600-24000
	SLR-D	500-24000
	SLR-F	80-550 1900-24000
	SLR-H	530-15600
Technical Radio Company	LRR-4	1500-18000
Western Electric Company	Standard receivers incorporated in radiotelephone equip- ment types.	
	224-A	2100-2800
	224-B ²	2100-2800
	226-A	2100-2800

¹When used with Radiation Suppressor Unit No. 1X381.

²When modified in accordance with manufacturer's instructions and such modification is designated by the addition of the letter "M" to the serial number of the modified receiver.

SERVICE NOTES

NAVSHIPS

900,000.1

COMMUNICATIONS

Manufacturer	Freq. range (kilocycles)	Type or model number
	226-B	2100-2800
	226-C	2100-2800
	226-D	2100-2800

BROADCAST RECEIVERS

Manufacturer	Freq. range (kilocycles)	Type or model number
Herbach and Rademan Company	AR-93	540-1600
	AR-93-A	540-1600
Maritime Radio Corpora- tion	MA-1	540-1600
	MA1-A ³	540-1600
	MA1-B ³	540-1600
Radio Corporation of America	ER-88	535-32000
E. H. Scott Radio Labs	SLR-12-A	540-1600
		5550-15600
	SLR-12-B	540-1600
		5550-15600

DIRECTION FINDERS

Manufacturer	Freq. range (kilocycles)	Type or model number
Bludworth, Inc.	Standard Bin- nacle	
	DF-1009	280-520
	DF-1011	280-520
	DF-1012	280-520
	DF-1013	280-520
	DF-1014	280-520
	DF-1015	280-520
	DF-1016	280-520
	DF-1017	280-520
	DF-1018	280-520
	DF-1019	280-520
	DF-1020	280-520
	DF-1022	280-520
	DF-1023	280-520
	DF-1024	280-520
Federal Telephone & Radio Corp	Mackay Radio & Telegraph Co.	
	102-A & B	250-540
	103-A & B	250-540

³Models MA1-A and MA1-B are identical in electrical design to the model MA-1.

Manufacturer	Freq. range (kilocycles)	Type or model number
	104-A & B	250-540
	105-A & B	250-540
	106-A & B	250-540
	102-BD	250-540
	103-BD	250-540
	104-BD	250-540
	105-BD	250-540
	106-BD	250-540
	AM-4490-DM	250-540
	AM-4490-EM	250-540
	AM-4490-F	250-540
Radiomarine Corporation of America	AR-8700-S	270-520
	AR-8701	270-520
	AR-8702	270-520
	AR-8702-A	270-520
	AR-8703	270-520
	AR-8704	270-520
	AR-8709	270-520
	AR-8700-ASX	270-520
	AR-8701-AX	270-520
	AR-8703-AX	270-520
	AR-8703-BX	270-520
	AR-8703-BX1	270-520
	AR-8707-X	270-520
	AR-8707-X1	270-520
	ER-1445-A	200-525
	ER-1445-B	200-525
	ER-1445-R	200-525

AUTO ALARMS

Manufacturer	Freq. range (kilocycles)	Type or model number
Federal Telephone & Radio Corp.	Mackay Radio & Telegraph Co. 101-B	500
Radiomarine Corporation of America	AR-8600-X	500
	AR-8601	500

This approval was given upon the condition that normal circumstances of operation, including applied voltages and electron tubes, will be maintained whenever the equipment is in use or operation.

UNAUTHORIZED COMMUNICATION RECEIVERS

The following equipments *do not* comply with FCC limitations and their use aboard U. S. vessels is *not* authorized:

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

Manufacturer	Freq. range (kilocycles)	Type or model number
	1P-501	37.5-1200
	1P-501-A	37.5-1200
	SE-143	92-970
	SE-1220	45-600
	SE-1420	
Arnessen Electric Company	841	80-31000
Ecophone Radio Co.	EC-2	550-30000
Federal Telephone & Radio Corp.	Mackay Radio & Telegraph Co.	
	104-B	500-23000
	105-A	16-1500
	117-A	16-35
		100-200
		300-550
		5200-19500
	117-B	16-40
		100-200
		300-550
		5200-19500
Federal Telephone & Radio Corp.	Mackay Radio & Telegraph Co.	
	122-A & B	300-500
	129-A	540-30000
Hallcrafters, Inc.	S-22R	110-1530
		1715-11500
	SX-24	545-43500
	SX-25	540-42000
Hammarlund Manufactur- ing Co.	SXR-200	535-20000
National Company	NC-44	550-30000
	NC-45	550-30000
Philips	614VN	550-5550
Radio Holland	UO	15-2100
Radio Corporation of America	AR-67	75-1500
Radiomarine Corporation of America	AR-8501	5000-1800
	AR-8504	300-900
	AR-8505	540-30000
E. M. Sargent	AH-10	34-14000
	12-D	34-14000
	12-UD	34-14000
	12-F	34-14000
	12-UF	34-14000
	11-51-TR	80-31000
Western Electric Company	Standard receivers incorpo- rated in radio-telephone equipment type	
	227-A	2100-2800

UNAUTHORIZED DIRECTION FINDERS

Manufacturer	Freq. range (kilocycles)	Type or model number
Federal Telephone & Radio Corp.	Mackay Radio & Telegraph Co.	
	AM-3800	300-500
	AM-4490-A	250-540
	AM-4490-D	250-540
	AM-4490-E	250-540
Radiomarine Corporation of America	AR-8700-AS	270-520
	AR-8701-A	270-520
	AR-8703-A	270-520
	AR-8703-B	270-520
	AR-8707	270-520

UNAUTHORIZED AUTO ALARMS

Manufacturer	Freq. range (kilocycles)	Type or model number
Radio Corporation of America	AR-8600	500

From time to time the Bureau receives information—usually via the "scuttlebutt"—that commercial receivers being installed aboard Navy ships for both entertainment and communications. A case in point is a certain destroyer having a Hallicrafter SX-28 receiver which was borrowed from or installed by the Army.

Tests by the Federal Communications Commission and the Naval Research Laboratory have shown repeatedly that all commercial Hallicrafter receivers have local oscillator radiations far in excess of the safe limit. It should be remembered that the Army does not have the receiver security problem that the Navy does and that it is useless and foolish to put safe receivers aboard a ship only to have the ship's security violated by a commercial receiver.

Commercial *broadcast* receivers can *not* be made safe merely by the use of preselectors due to their usual "spread-out" construction and wooden or plastic cabinets which provide excellent opportunities for radiation.

ALIGNMENT OF INTERMEDIATE-FREQUENCY AMPLIFIERS

In the alignment of intermediate-frequency amplifiers in radio receivers it is important that the connection of the signal generator have no effect on any d-c voltages that

may be applied to the grid and that no incoming signals be fed into the mixer tube.

The network shown in Figure 1 has been found highly satisfactory as a means of coupling a signal generator into an intermediate-frequency amplifier. No specific details for its construction are given as no special precautions are necessary. The condensers should be of the bakelite encased mica type (Cornell-Dubilier type 4 or equivalent) and the resistor should be rated at $\frac{1}{2}$ watt (IRC type BT $\frac{1}{2}$ or equivalent). The two condensers may be stacked one on the other and the resistor connected between them at one end. It may be tucked between the terminals of the condenser. Flexible test lead wire may be used for connection to the receiver; battery clips may be used to connect the wires to the tube top cap and its connecting wire. The whole "gadget" may be covered with vinyl or rubber tape, leaving the condenser terminals exposed so as to permit clipping on leads from the signal generator. The tape forms a durable and insulating protective cover.

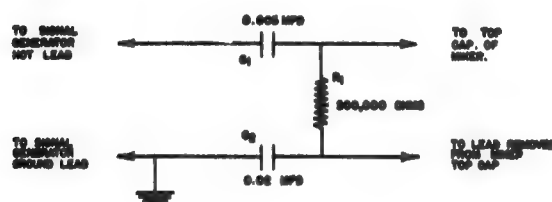


FIGURE 1.--Network for coupling a signal generator to an i-f amplifier

In use, the wire leading to the top cap (signal grid) of the mixer tube is removed and the wire from the 0.005-mfd condenser is clipped to the top cap of the tube. The wire from the 0.02-mfd condenser is clipped to the wire which was removed from the mixer tube's top cap. It will be noted that the resistor R_1 is substituted for the tuned circuit in the grid circuit of the mixer and that any signals coming from the tuned circuit are bypassed to ground through C_2 . R_1 also provides a path for any d-c grid bias on the mixer. The signal from the signal generator is coupled to the mixer tube through C_1 . No d-c voltages in the receiver are disturbed.

This network is easily adaptable for use with single-ended mixer tubes such as the type 6SA7. In such cases the signal from the signal generator may be fed into the mixer through C_1 by clipping the lead from C_1 to the signal grid of the mixer or to the stator of the variable condenser tuning the signal grid circuit of the mixer. This latter connection is often more accessible than the connection to the signal grid. The variable condenser should be adjusted to its maximum capacity in order to provide a high impedance at the intermediate frequency. Care should be taken to adjust the tuning condenser to a "quiet spot" i.e. one that is free from received signals and/or heterodynes between the signal, generator signal, and its harmonics and the local oscillator in the receiver and its

harmonics. If extreme difficulty is encountered in finding a "quiet spot" near maximum capacity, the local oscillator in the receiver may be "killed" for alignment purposes by clipping a large condenser (0.05 mfd or larger) across the oscillator section of the variable condenser.

All connections should be restored to their original status following the completion of the alignment.

NEED FOR CAUTION WHEN USING REPAIR SHOP ANTENNAS

Users of repair shop antennas should exercise caution to insure the absence of receiver radiation when testing and aligning receivers while the ship is in restricted areas.

ELIMINATION OF RADAR INTERFERENCE IN RADIO RECEIVERS

Interference has been encountered in some types of radio receivers due to the effects of radar transmitters. The following methods are effective in elimination of this interference and should be followed in all cases where the problems exist. Basically the problem is proper shielding and bonding. It is requested that vessels report immediately to this Bureau (Code 965) any other methods which have been attempted and which have been successful to any degree.

A major interference problem has been encountered in outfitting certain types of destroyer escorts. Two designs of DE's are being built; one has a bulkhead separating the SA and SL transmitters from the radio receivers, while the other design has not. In both designs the radar transmitters are 6 to 7 feet away from the radio receivers and are causing interference in those installations without the separating bulkheads.

Due to constructional difficulties relocation of transmitters and installation of shielding bulkheads cannot be permitted and are not authorized in DE installations.

The problem has been solved after extensive tests by treating the sources; i.e., the radar transmitters with some attention given to the radio receivers and antennas. Consideration will also have to be given to certain installation procedures.

In submarines, where the SD transmitter is in the vicinity of the radio receivers, the same basic interference problem exists. However, the following comments, while applying particularly to DE installations with SA and SL are general and should be considered for all types of installations in other type vessels:

- Double the shield power cords to the radio receiver and ground both ends of the shield.
- Check all ground connections, making sure they are terminated to surfaces that have been scraped bright and clean and are free of paint and secured firmly.
- Provide *short ground straps* from receiver cases to metal shelf on table upon which receivers are mounted.
- Connect receiver ground terminals to receiver cases with short ground straps, which may be the continuation of the ground strap to the metal shelf or table supporting the equipment.
- Completely shield the receiver antenna leads. The slightest part exposed will be a source of r-f pick-up. In those receivers where coaxial patch cords are not

used, it is advisable to use a metallic cover over the antenna terminals grounded to the case, and a shielded lead-in. (A method employing a coaxial connection is being considered with necessary fittings to adapt wave traps. However, until such time as this line is available, shielding to approximate a coaxial line should be attempted.)

The construction details of the National receivers RAO and RBL are such that r-f more easily enters the case through dial openings and edges. When these are located near the radar transmitter, possibility of interference is enhanced. It is, therefore, suggested that if after entering service, interference exists although the preceding and succeeding expedients are taken, the RAO and RBL be interchanged with the RAK/RAL.

Direct pick-up into the receiver antenna at certain bearings of the radar antennas has been noted in some installations. In some cases this may necessitate a relocation of receiver antennas so that they are directly below both radar antennas.

During installation of radar equipment the power and pulse cables should emerge from the same opening and be grounded at the same point on the transmitter case. These as well as all cables should be bonded at the nearest point to a deck or bulkhead. It is imperative that no closed loops be formed by any cables associated with any radar equipments internal or external.

MULTI-CHANNEL RADIO-TELEGRAPH SYSTEM OVER-ALL OPERATION

Telegraph signals have been transmitted over radio paths practically since radio transmission was made possible. There has been a constant effort to increase the speed of transmission and to eliminate the need for human processes. Thus, we had the ordinary manual telegraph key, the speedier "bug" key leading to automatic high speed tape transmission and reception of dot-dash signals. The latter is now widely used by means of efficient vacuum tube circuit arrangements.

The use of printing telegraph equipment affords many advantages in eliminating the human tape decoding factor, and in other ways provides speed and convenience advantages. However, the problems presented by short wave radio transmission and the high degree of transmission stability demanded by printing telegraph equipment are comparatively difficult to overcome. While printing telegraph equipment has been used over radio circuits, it has usually been necessary either to design a new teletypewriter arrangement or to otherwise incorporate features of new design. The multi-channel radiotelegraph system soon to be furnished to the Navy provides for the transmission of as many as six standard 60-word speed teletypewriter circuits over one of the two voice channels of a single sideband short wave radio system.

It should be noted that the sudden and urgent need for multi-channel radio teletypewriter operation, because of the war, prohibited any prolonged equipment development. Standard teletypewriter equipment, standard telegraph land lines, and standard radiotelephone facilities were available and it was necessary to devise arrangements to permit the successful interconnection of these facilities. In the

multi-channel radiotelegraph system, this interconnection is provided by a specially designed voice frequency carrier telegraph system.

A standard single sideband short wave radiotelephone system incorporates many transmission advantages. Briefly, these advantages comprise the effective improvement in signal to noise by 9 db due to the effective suppression of the carrier and the use of only one sideband thus using maximum transmitter power for the intelligence carrying frequencies and minimizing noise by reducing the receiver band width. Furthermore, the system is less subject than a double sideband system to the effects of selective fading and interference. However, a single sideband radiotelephone circuit, nevertheless, is affected at times by severe radio fading.

We have long had the voice frequency carrier telegraph system wherein as many as 18 d-c teletypewriter circuits are combined in the voice frequency spectrum of a telephone circuit. Such systems were designed for land line telephone circuits and are highly effective for this purpose. The standard voice frequency carrier system is basically an amplitude modulation system and, with level compensation, operates efficiently with the comparatively small attenuation changes affecting land line telephone circuits. The comparatively large and fast attenuation changes and noise affecting long haul short wave radiotelephone circuits make impracticable the use of such standard voice frequency carrier telegraph systems and it has been necessary to design a special voice frequency carrier telegraph system which will be less subject to the difficulties resulting from radio fading and noise. Briefly, the new carrier telegraph system provided for the replacement of amplitude modulation by using certain essentials of frequency modulation, by using frequency diversity and teletypewriter signal synchronization.

The various components of an over-all multichannel radio telegraph system are shown in Figure 1. At the left in Figure 1 are shown six teletypewriter stations which communicate respectively with the six teletypewriter stations at the right. The respective stations are operated on a full duplex basis, i.e., two separate one-way circuits for simultaneous operation. The transmitting source of signals consist of a standard transmitter distributor, whereby teletypewriter characters from perforated tape can be continuously transmitted to the telegraph line or consists of a teletypewriter keyboard. While signals can be received by a teletypewriter, they are usually received by a typing re-perforator whereby the received messages are in the form of perforated tape on which the message is also imprinted, thus providing for the immediate retransmission of this tape to another location. Signals to and from the six stations at the left of Figure 1 are respectively transmitted over six standard full duplex land line telegraph circuits to the special voice frequency carrier telegraph terminal.

The specially designated voice frequency carrier telegraph equipment transforms the six d-c signals in one direction into six two-tone voice frequency carrier signals. The discrimination between marking and spacing is conveyed by a change from one tone to another so as to permit constant amplitude operation during both conditions. The

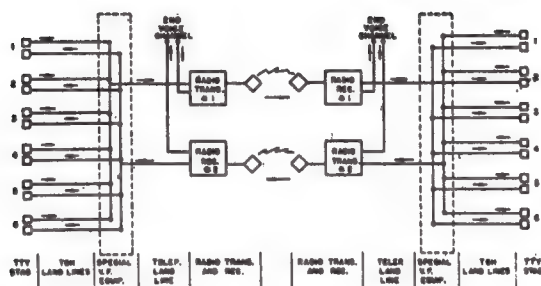


FIGURE 1.--Components of an over-all multi-channel radiotelegraph system.

combined voice frequency tones are transmitted over the radiotelephone system in the same manner as speech signals.

The short wave single sideband radiotelephone system provides two separate telephone circuits. Thus, radio transmitter no. 1 on Figure 1 provides for two voice input channels. The six teletypewriter signals in the form of voice frequencies of one voice channel constitute one of the two channels of the radio transmitter. It may be noted that the other radiotelephone circuit afforded by the signal sideband system is not required for the over-all multi-channel radiotelegraph system and may be used for telephone purposes, telephoto, or other transmission including the transmission of a second group of six teletypewriter circuits. The radio transmitter transforms the voice frequency signals to radio-frequency signals in the range of four to twenty-two megacycles and feeds them to the directional rhombic antenna where they are radiated.

Radio signals from transmitter no. 1 are received by the rhombic directional antenna and single sideband radio receiver no. 1. Here the two demodulated voice channels are derived and passed over separate one-way telephone lines. The voice channel which comprises the original six teletypewriter signals is sent to the special voice frequency carrier equipment where it is converted into six separate teletypewriter signals for transmission over six land line teletypewriter circuits to the six respective stations. Transmission in the reverse direction is exactly similar and requires duplicate equipment in the reverse order. The two directions of transmission are electrically separate throughout.

The successful operation of the multi-channel radiotelegraph system lies in the degree to which the fading and noise of the radiotelephone circuit can be overcome. A number of these systems have been used by the Army for some time with successful results.

HOW TO USE THE TUNING FORK AND STROBOSCOPIC TARGET TO ADJUST TELETYPEWRITER MOTOR SPEEDS

The motors which operate teletypewriter apparatus are equipped with a speedmeasuring device which consists of a stroboscopic target having alternate black and white

spots. This target is viewed through a special tuning fork and when the motor speed is correct the target spots appear stationary.

Occasionally difficulty is experienced since there are other incorrect motor speeds at which the target spots will appear stationary. To alleviate this difficulty some motors are equipped with two targets and it is not always clear which target should be used.

Also, occasionally, due to rather special circumstances, it is necessary to change the motor speed of transmitter-distributors, teletypewriters or other teletype equipment from the standard speed. This, of course, should not be done except when the necessity is clearly indicated, such as in the case when American machines operate on a network having both American and British teletypewriters. This article gives some information concerning methods of computing motor speeds and records some computations of available speeds.

The standard American teletypewriter tuning fork vibrates 87.6 times per second and is equipped with slotted shutters so that the target on the motor shaft is viewed 175 times per second (2×87.6). In the case of a motor with a 10 black spot target and a speed of 35 revolutions per second, the number of black spots passing a given point in a second will be 350. This is divisible by 175 and therefore during the interval of time between views of the target exactly two spots would pass a given point and the spots would appear stationary. If the motor speed were 17.5 revolutions per second every spot would be viewed. If, however, the target had 20 black spots instead of 10 and every spot was viewed, the motor speed would be half of 17.5 revolutions per minute. From this discussion it will be fairly clear that:

$$\text{R.P.S.} \times N/175 = I \text{ (Whole number 1,2,3,4, etc.)}$$

$$\text{R.P.S.} = 1751/N$$

$$\text{R.P.M.} = 60 \times 1751/N = 10,5061/N$$

$$\text{R.P.S.} = \text{Revolutions per second of motor.}$$

$$N = \text{Number of black spots on target.}$$

$$I = \text{An integer.}$$

A tuning fork which vibrates at the rate of 96.19 cycles per second is also available. This fork was designed for use with teletypewriters which operate at 404 operations per minute and coordinate with British machines. This fork gives speeds which are about 10 percent higher than the standard 87.6-cycle fork.

Tables A, B, and C record computations of speeds obtainable with various targets and various tuning forks.

Targets with a large number of spots have the disadvantage that there are several speeds at which the target will appear stationary and hence the speed may be adjusted to the incorrect value.

When the motor speed is fast it will be noted that the target spots appear to travel in the direction of rotation and when the motor speed is slow the target spots appear to travel opposite to the direction of rotation. The amount of

Table A.--Motor speeds obtainable with targets having a certain number of black spots

Target	Motor speed (revolutions per minute)		Target	Motor speed (revolutions per minute)	
	87.6 Fork	96.19 Fork		87.6 Fork	96.19 Fork
7, 14, 21, 28, 35	1502	1649	35, 30, 25, 20, 15, 10, 5	2102	2308
34	1546	1698	34	2164	2376
27	1557	1710	29	2175	2388
20	1577	1732	24	2190	2405
33	1593	1749	19	2213	2430
13, 26	1617	1776	33	2230	2449
32	1642	1803	14, 28	2252	2472
19	1660	1823	23	2285	2508
25	1682	1847	32	2300	2525
31	1695	1861	9, 18, 27	2336	2565
6, 12, 18, 24, 30	1752	1923	31	2374	2605
35	1802	1978	22	2389	2623
29	1812	1989	35	2403	2638
23	1828	2007	13, 26	2426	2664
17, 34	1855	2036	30	2453	2693
28	1877	2061	17, 34	2473	2715
11, 22, 33	1911	2098	21	2503	2748
27	1947	2138	25	2523	2772
16, 32	1971	2164	29	2537	2785
21	2002	2198	33	2548	2798
26	2021	2219	4, 8, 12, 16, 20, 24, 28, 32	2628	2886
31	2035	2234			

speed deviation in any case can be estimated as in the following example: If a motor operated at a speed of about 35 revolutions per second and was equipped with a 10-spot target, 350 black spots would pass a given point in a second. If 351 black spots passed a given point the spots would appear to progress at the rate of 1 per second. Therefore, the actual speed would be:
 $351/350 = 1.00286 = 0.286$ percent fast

In case the motor speed desired is in doubt, various methods may be used to determine the one to use. One method which is very useful on such machines as tape distributors is to measure the length of tape passed through the distributor in 1 minute. The tape is perforated with 10 characters per inch so if, for example, 368 characters were desired 36.8 inches of tape should pass through the gate in 1 minute. When the motor speed is about correct as determined in this manner, it may be adjusted more accurately by means of the tuning fork and target.

The ratio of the gears used in transmitter distributors is occasionally in doubt. For example, it may be known that the gear ratio is either 7:40 or 9:44. One method of determining which gears are installed is to turn the motor over by hand. If 7:40 gears are installed, it will be found that the motor must be turned 40 revolutions for the brush arm to return to its starting point, while if 9:44 gears are installed it will be necessary to turn the motor 44 revolutions.

It is convenient to be able to remember some of the constants such as the rates of vibration of the tuning forks. The speed of the standard American tuning fork can be remembered fairly easily by noting that the first number is

TABLE B.--Motor speeds obtainable with targets having a certain number of black spots and 87.6-cycle fork

Target (number of black spots)	Motor speed (revolutions per minute)	
(1)		
4	2628	
5	2102	
6	1752	
7	1502	(2)
8	2628	
9	2336	
10	2102	
11	1911	(3)
12	1752	2628
13	1617	2426
14	1502	2252
15	2102	(4)
16	1971	2628
17	1855	2473
18	1752	2336
19	1660	2213
20	1577	2102
21	1502	2002
22	1911	2390
23	1828	2285
24	1752	2190
25	1682	2102
26	1617	2021
27	1557	1947
28	1502	1877
29	1812	2175
30	1752	2102
31	1695	2035
32	1642	1971
33	1593	1911
34	1546	1855
35	1502	1802

(2) Indicates every second spot is viewed, etc.

TABLE C.--Motor speeds obtainable with targets having a certain number of black spots and 96.19-cycle fork

Target (number of black spots)	Motor speed (revolutions per minute)	
(1)		
4	2886	
5	2308	
6	1923	
7	1649	(2)
8	2886	
9	2565	
10	2308	
11	2098	(3)
12	1923	2886
13	1776	2664
14	1649	2472
15	2308	(4)
16	2164	2886
17	2036	2715
18	1923	2565
19	1823	2430

8 and the next two numbers are obtained by subtracting 1 from each preceding number (87.6).

The 96.19 fork is 10 percent higher, less about two parts in a thousand.

RADIO-TELETYPE REPEATER

The following covers a simple method of constructing a radio-teletype repeater capable of accepting a neutral

TABLE C.--Motor speeds obtainable with targets having a certain number of black spots and 96.19-cycle fork--(Con.)

Target (number of black spots)	Motor speed (revolutions per minute)			
	(3)	(4)	(5)	
20	1732	2308	2886	
21	1649	2198	2748	
22		2098	2623	
23		2007	2508	(6)
24		1923	2405	2886
25		1847	2308	2772
26		1776	2219	2664
27		1710	2138	2565 (7)
28		1649	2061	2472 2886
29			1989	2388 2785
30			1923	2308 2693
31			1861	2234 2605 (8)
32			1803	2164 2525 2536
33			1749	2098 2449 2798
34			1698	2036 2376 2715
35			1649	1978 2308 2638

(2) Indicates every second spot is viewed, etc.

d-c output from a frequency-shift-keyer receiver-adaptor and repeating this signal into a single send/receive loop, and capable of accepting a signal from the send/receive loop and repeating it through to a frequency-shift-keyer. Through the arrangement shown, the incoming signal from the f-s-k receiver-adaptor does not repeat back to the keyer on the send side, and the use of a single send/receive loop teletypewriter on a two-way radio circuit is permitted, with operation on a simplex basis.

The Bureau of Ships has procured standard repeater equipment to perform the function of this simple repeater and other functions as well. This equipment is known as the Navy Model PM Teletypewriter Repeater. Occasions may arise, however, when conditions would warrant the construction of the unit described in the following paragraphs as an interim or emergency measure. The suggestion is passed on to the field, therefore, to be used wherever and whenever it may become desirable.

DESCRIPTION OF THE RADIO-TELETYPE REPEATER.—The RATT Repeater allows the operation of duplex radio-teletype into one-or two-wire simplex. It consists primarily of three relays (Western Electric Co. 255-A), a bias meter, a model 10 rectifier, and a current-regulating resistor, all mounted on a chassis 4 inches wide, 4 inches deep, and 12 inches long.

This repeater unit was designed to allow the operation of radio-teletype with existing station equipment, thus eliminating the necessity for the terminal machines that are generally used. This also allows any station in the local network to use radio-teletype directly, with the existing switchboard or concentrator system, and eliminates the necessity for relaying radio-teletype messages between the central station and stations not equipped with radio-teletype by the use of the regular calling procedure.

THEORY OF OPERATION.—A transmitted signal from the station coming into the switchboard or concentrator is

sent through the "mark" winding on relay 1 and on through the contacts of relay 2. This signal activates relay 1, opening and closing the contacts, and thus keying the FSA line and transmitter. The signal received from the switchboard has no effect on relay 2, since it goes through the contacts which are closed on the steady marking signals from the model FRF converter.

When a radio-teletype signal is being received, the FRF keys both relay 2 and relay 3 as previously stated. (The line from the switchboard goes through the contacts of relay 2.) When the FRF keys relay 2, it opens and closes the switchboard circuit, keying the machine that is patched into the switchboard. To avoid keying the transmitter with the received signal, relay 3 is used. The winding of relay 3 is in series with relay 2, and consequently both are keyed at the same time by the FRF signal. The contacts of relay 3 are wired so as to short out the line to the FSA on the spacing impulses; thus, the circuit to the FSA is kept closed at all times while a signal from the FRF is being received.

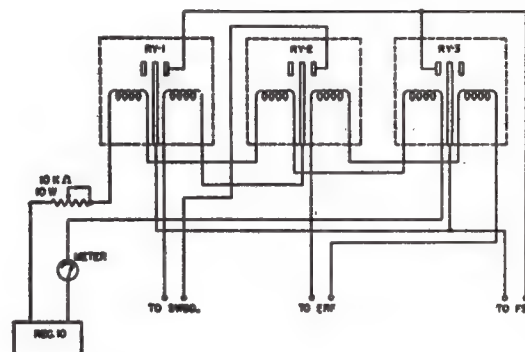


FIGURE 1.--RATT radio-teletype repeater

This repeater has been built and given a thorough test. It keys equally well by hand or with automatic transmitter, but only a simplex operation is now permitted.

AUTOMATIC TELETYPE CARRIAGE-RETURN AND LINE-FEED ATTACHMENT

The Bureau of Ships has procured a quantity of kits manufactured by Teletype Corporation (part no. 105382). These kits have been assigned stock number N17-T-350004-341. They were designed to eliminate letter "pile-up" and "over-lap" on those teletype printers operating over radio circuits wherein fading of the received signal might cause loss of the line-feed or carriage return signal. Installation instructions are included with the kit.

NONAVAILABILITY OF MAINTENANCE PARTS FOR ELECTRIC SPRAYIT COMPANY MOTORS

Maintenance parts for the TE106875 and TE107151 motors cannot be supplied, principally because tools and

casting molds for these two motors have been scrapped. The parts that are effected are as follows:

Teletype part no.	Description	FSN stock No.
110 306	Bearing Lock plate	N5815-412-8567
110 307	Armature	N5815-412-8568
110 308	Bolt	N5815-412-8569
110 312	Washer, spring	Not assigned
110 314	Washer, felt	N5815-412-8571
110 316	Brush, cap	N5815-412-8572
110 323	Felt, retainer	Not assigned
110 324	Felt, washer	N5815-412-8573
110 325	Felt, retainer	N5815-412-8574
110 326	Set screw	N5815-412-8575
110 327	Fiber bushing	N5815-412-8576
113 941	End shield	Not assigned
113 943	Armature	Not assigned
113 942	Field and shield	Not assigned

Due to a quantitative supply of Sprayit motors in the Electronic Supply System, all activities are requested to requisition a replacement motor TE106875 SNS No. N17-M-requisition a replacement motor TE106875 or TE107151 instead of the above-listed maintenance parts. The inoperative Sprayit motors are to be cannibalized by all activities for maintenance parts.

As soon as stocks are exhausted, the Electronic Supply Office will replace all Electric Sprayit Company's motors with TE77953 motors.

TELETYPE TEST ADAPTOR

A beneficial suggestion for a d-c test adaptor to facilitate testing FSA keyers, FRA receivers, and teletype printers has been submitted by the San Francisco Naval Shipyard. This test adaptor provides for testing facilities where 120-volt d-c power is available, thus eliminating the need for a bulky and heavy rectifier unit.

Model 15 Teletype Equipments and Projector Equipments intended for shipboard use are designed to use d-c power furnished directly by the ship's generator room. Since the adaptor weighs only four pounds its portability and convenience are far superior to that of a suitable portable rectifier, which weighs about 45 pounds.

The adaptor is so designed that it may be plugged in directly to a 120-volt d-c line. It allows the servicing technician complete local control and provides meter readings of all voltage and current being used by the teletype equipment. The local control feature of this adaptor eliminates the danger of energizing a circuit that may involve other personnel or equipment.

In addition to the safety and convenience factors noted above, this adaptor permits considerable savings in time when servicing and testing teletype equipment. When used to test the FSA keyer, the adaptor eliminates the need for disassembling the plug of the keyer and the transmitter-

distributor to get the desired signal. This signal, which should be of a specified voltage, may be regulated and measured by use of this adaptor. In this way the FSA keyer may be checked for operation at maximum and minimum signal input.

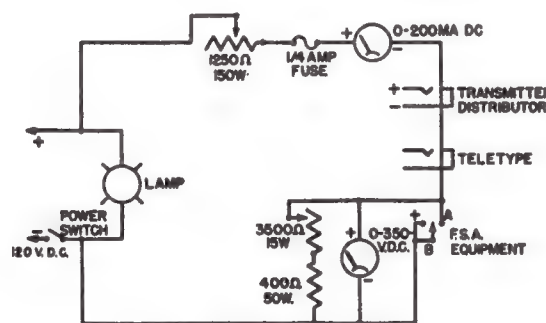


FIGURE 1.--Test Adapter Circuit

By using the stand-by switches, the adaptor may be employed to check the FSA keyer without the use of any signal source. This may be done by setting Switch No. 2 to "Stand-by" and setting Switch No. 1 to "Operate."

Previously, no test of the FRA Receiver could be made without the use of extensive makeshift wiring. By placing the transmitter-distributor in the circuit, the FRA Receiver may be checked for "mark" and "space" pulses with the test adaptor.

For additional checking a teletype printer may be jacked into the panel for monitoring; this also was not possible without the test adaptor.

By use of the adaptor, the teletype equipment may also be tested by feeding a minimum current to the magnets. This is a quick way to tell whether the machine is in proper adjustment or not. If adjustments are not correct, the machine will not operate correctly.

The adaptor permits checking the teletype machine while it is running for long periods of time. Thus constant readings of voltage and current in the circuit are possible and any changes of these values may be easily noted.

TELETYPEWRITER MOTOR REMOVAL SUGGESTION

The electronics shop at Mare Island Naval Shipyard has made the beneficial suggestion that a male and female line-cord plug be inserted in the Model M-14 teletypewriter motor leads where they pass behind the typebar comb. The connector is shown inserted in the motor leads in Figure 1. In Figure 2 (See Page 4-7) the location of the plug is shown when the motor is in operating position. 4/1/50

JAN DESIGNATIONS FOR TELETYPE AND TELEGRAPH EQUIPMENT

This article contains official JAN designations for teletype and associated telegraph equipment. The Bureau of Ships realizes that information on teletype nomenclature has been urgently needed. The material presented therein

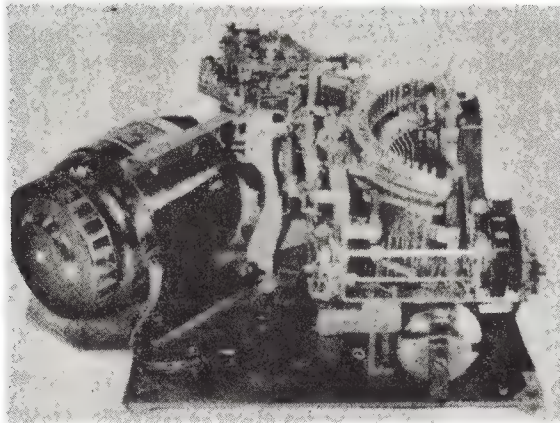


FIGURE 1.--Model M-14 teletypewriter showing plug in motor leads

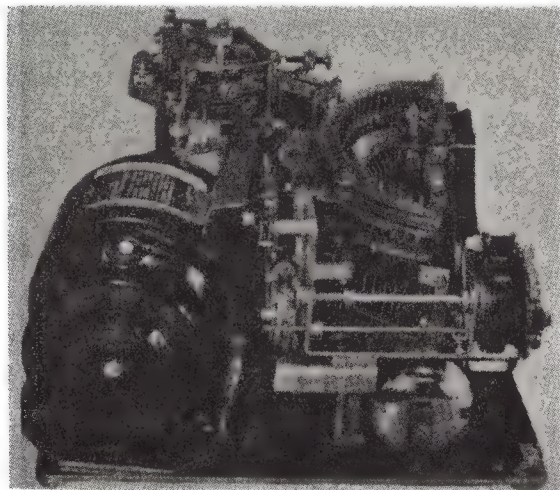


FIGURE 2.--Model M-14 teletypewriter showing motor in operating position

is intended to fill that need. (The list contains designations for all general service teletype equipment used by Naval Shore Activities.)

Correspondence from field activities concerning teletype equipment has referred to JAN type designations which have since been superseded and are not in current use. In many instances equipment descriptions are not informative enough for prompt and proper action. It is recommended that this list be used for identifying and reporting purposes.

Subsequent to this publication a directive (NN/S67 (916) E M8/A2 ser: 915-1809 of 24 June 1952 from Chief of Bureau of Ships to all Industrial Manufacturing Commander in Chief of Eastern Atlantic and Mediterranean, Commander Service Forces Pacific) promulgated by the Bureau

of Ships to all shore activities which, when used in conjunction with the description, will enable activities to identify and label all general service teletype equipment.

JIG FOR ALIGNMENT OF TYPE PALLETS ON A TELETYPE TYPING REPERFORATOR

A beneficial suggestion has been submitted for the fabrication of a simple jig that can be used to align type bars and pallets on a Teletype Typing Reperforator.

As a result of continuous pounding of pallets on the platen, physical distortion occurs in a type bar and pallet causing imperfect and uneven characters to be printed on the tape.

The jig will correct this situation in about an hour. It not only reduces the time originally required to perform this work; but insures excellent alignment of pallets, and results in straight even printing of characters.

Complete fabrication details of the jig are shown in Figure 1 and 2. It is shown assembled in Figure 4. It can readily be attached in the drilled and tapped holes, already provided for the ribbon guide mounting as shown in Figure 3.

TELETYPEWRITER RIBBONS

Several activities find it difficult to use standard teletypewriter ribbons in teletypewriters. An investigation reveals that the metal reversing attachments on ribbons supplied by some manufacturers are not the proper size and shape to permit satisfactory operation of the ribbon reverse mechanism. Another cause of unsatisfactory results is the corrosive reaction of ink on the unprotected metal reversing attachments.

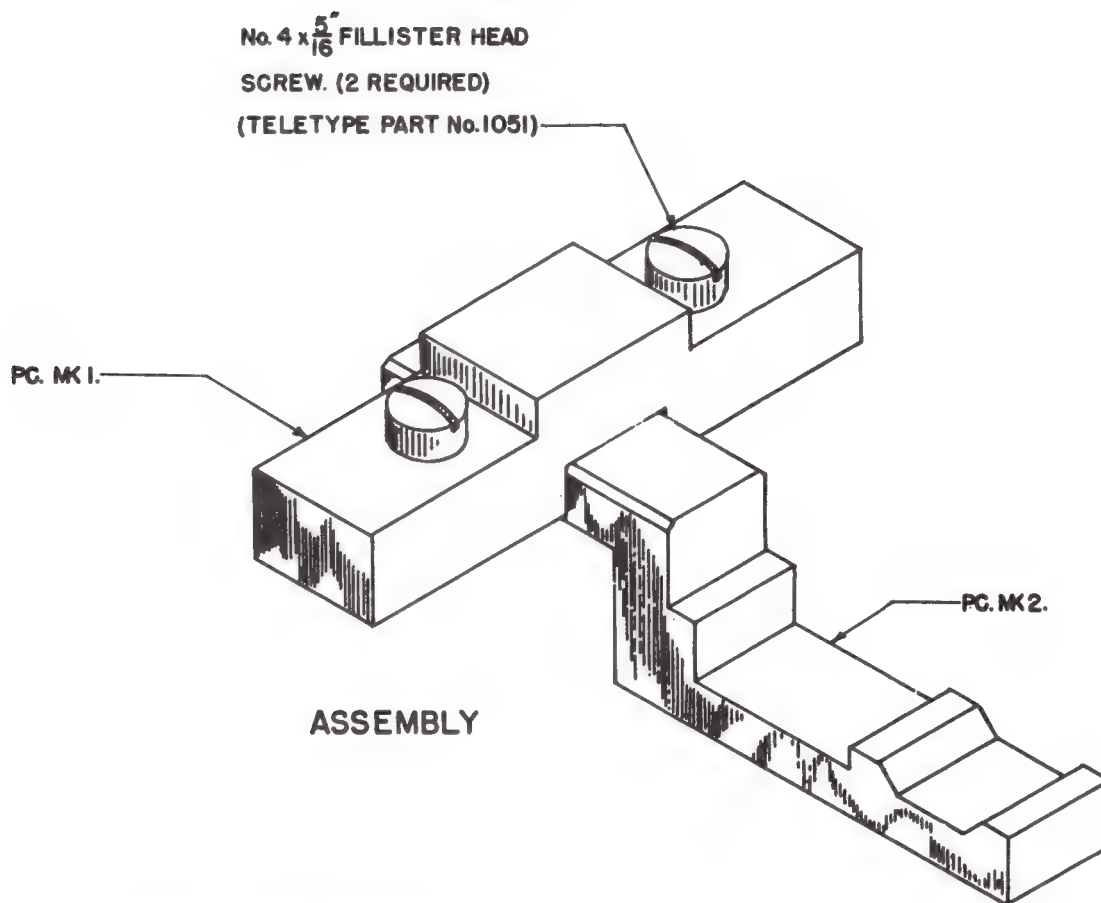
The General Stores Supply Office has requested the Bureau of Supplies and Accounts to correct the above conditions by modification of Federal Specification DDD-R-306 of 5 May 1952 as follows: On page 2 insert the following paragraph:

"3.10.1 REVERSE ATTACHMENT—Each ribbon shall be provided with metal reversing attachments that shall be no less than 0.070 inch thickness, and shall be of such size and shape that the area shall occupy not less than the width of the ribbon. The metal used in the reversing attachments shall not corrode from contact with the inked ribbon."

Do not use in teletypewriters, ribbons, labeled typewriter or teletypewriter which do not have satisfactory metal reversing attachments. Experience indicates that ribbons manufactured by the Codo Mfg. of Corapolis, Penn., or by the Buckeye Ribbon and Carbon Co. of Cleveland, Ohio are satisfactory for use in teletypewriters.

TELETYPEWRITER LINE UNIT

Mr. Alphonse Pare of Portsmouth Naval Shipyard has submitted as a beneficial suggestion a teletypewriter line unit—an electrical device to furnish line current and provide the means for connecting teletypewriters for "Local Test" or to a "Loop Circuit". This suggestion is now in use in Shop 67.



**NOTE: FABRICATE FROM CORROSION
RESISTANT MATERIAL.**

FIGURE 1.--Jig Fabrication Details

The procedure for operating and determining the operating efficiency of a teletypewriter is to "Local Test" it. The requirements for doing this are, first, a source of 115 V d.c. or a.c. power for running the motor, depending on the type motor. Also needed is a source of 115 V d.c. at 60 ma for energizing the selector magnet. Mr. Pare's device is designed to meet these testing requirements. It provides an indicator and facilities for connecting one machine in a "Local Test" circuit or two machines in a "Loop Circuit" for testing and instruction purposes.

The line unit is housed in a metal box 5-3/8 in. wide by 4-3/4 in. high by 3-5/8 in. deep, as shown in the schematic (figure 1). The components of the unit are: ON-OFF line switch, protective 1/4 amp. fuse, 0-100 ma indicating meter, 1000 ohms current limiting resistor, 5000 ohms rheostat current adjusting resistor, 2500 ohms line voltage dropping resistor, 2 closed circuit jacks for connection of one or two machines.

A 6-foot power cord with a polarized plug for connection to a convenient source of direct current is located at the

rear of the line unit. A DPDT switch is also provided to measure the incoming line voltage without interruption to the test or loop circuit. This switch is spring-loaded so that after the line voltage test is accomplished it will return to "Loop Circuit" position. The 1.02 ohm resistor shunts the meter and makes it capable of reading from 0-100 ma current. For the motor, a.c. current is obtained separately from the convenient a.c. outlet. The fuse value for the equipment under test should not exceed 100 milliamperes; however, this fault may be corrected by the replacement of the fuse in the fuseholder with a 100 milli-ampere fuse.

The Teletypewriter line unit is a compact electric device weighing approximately 3 lbs. It simulates auxiliary controls used at the site to teletypes. The use of this device means that one or two multiple installations can be brought to Shop 67 for mechanical or electrical diagnosis, for repair or overhaul; and tested under actual operating conditions. (See Figure 1, below)

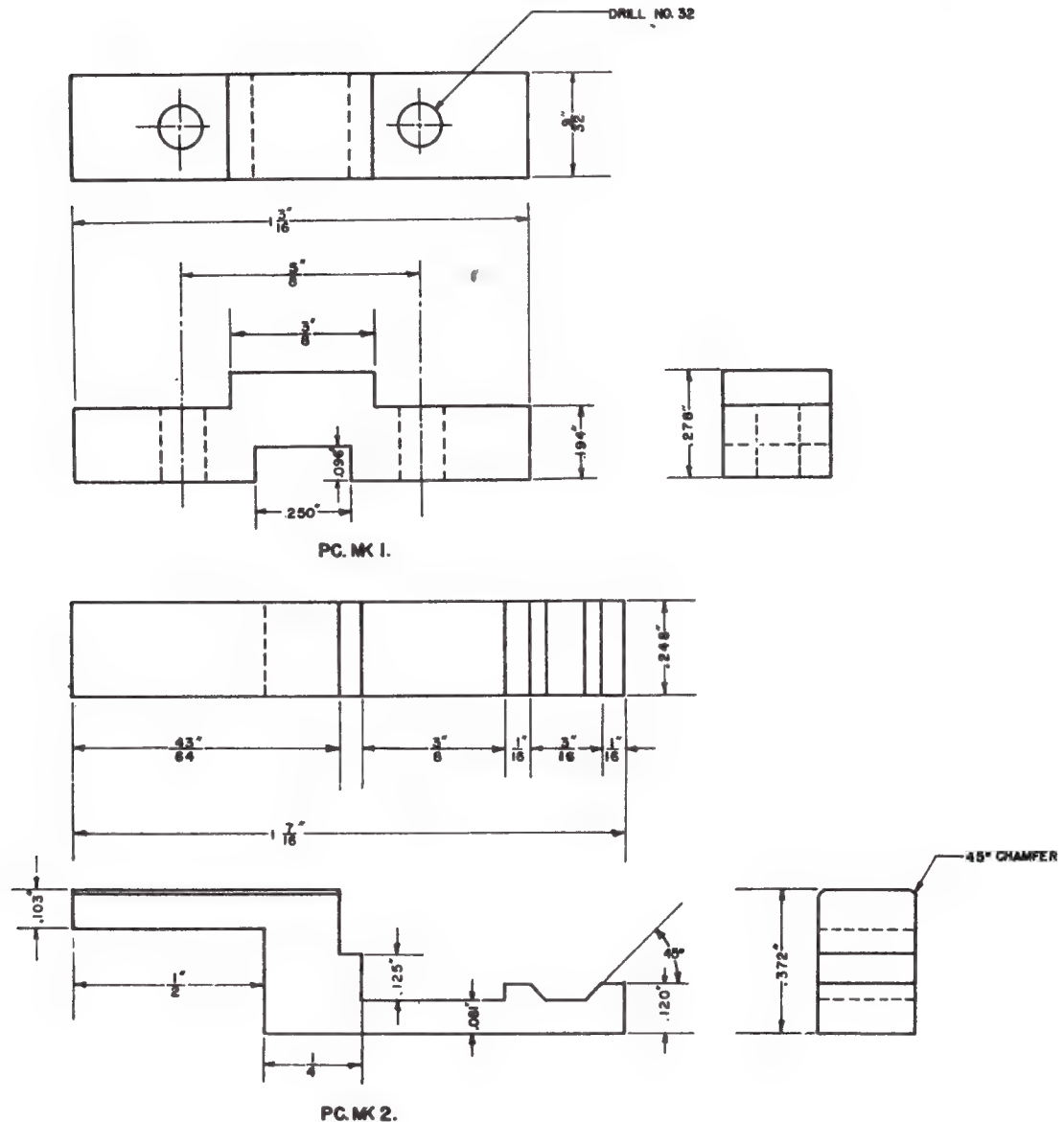


FIGURE 2.--Jig Construction Details

STOCK STATUS AND DIMENSIONS OF FACSIMILE RECORDING PAPER

All facsimile recording paper is produced in standard dimensions.

Times facsimile duplicating paper ("TIMEFAX") is a dry recording paper which contains aniline dye with a gelatin pad backing for use in producing multiple copies.

Times facsimile nonduplicating paper ("TIMEFAX N. D.") is a single copy white surface paper with a white paper backing. Procurement of the above paper is at the rate of 2,000 packages per year.

"Teledeltos" paper is gray surface paper with a graphite base back. "Teledeltos" is a single copy paper.

Equipment	Paper size	Type of paper	Sheets per pkg.
TT-41/TXC-1B	12" x 18-11/16"	Timefax N.D. or Teledeltos	250
RD-92/UX Recorder	12" x 19-1/8"	Timefax N.D. or Teledeltos	250

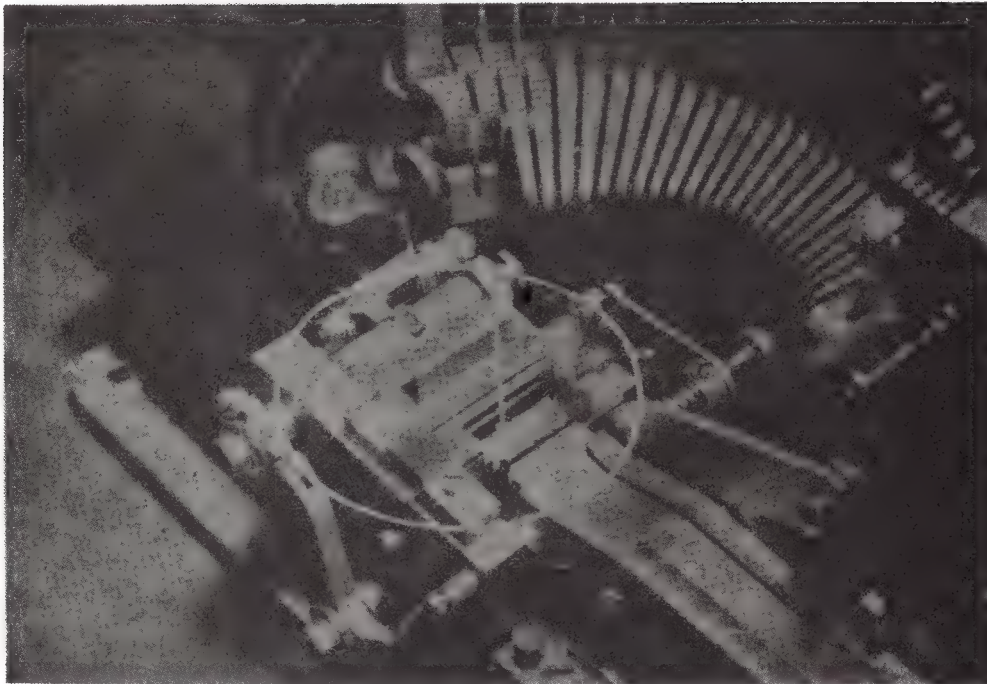


FIGURE 3.--Jig Installed in Reperforator

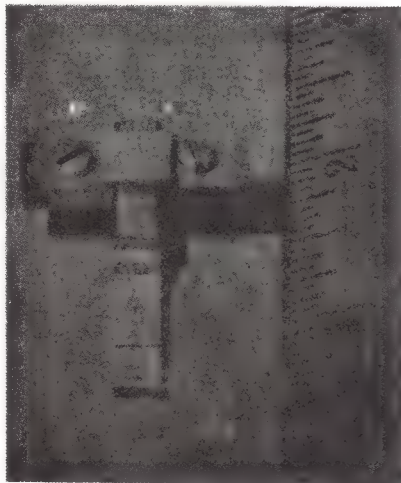


FIGURE 4.--Jig

WRENCH FOR TELETYPE TRANSMITTER DISTRIBUTOR

Mr. James A. Gillian of Philadelphia Naval Shipyard suggests a new type wrench (See illustration) for adjusting cams on teletype transmitter distributors. This wrench is now in use at Shop 67. Previously, a single jaw spanner

type wrench was used for this purpose but it proved inadequate. The cam adjusting nut was so thin that it necessitated the use of a thin wrench with a very small jaw or tooth to fit the slot in the cam nut. When pressure was applied to the wrench, if too great a resistance was met, the wrench would either slip from the nut, or the tooth of the wrench (being its weakest part) would break off. Mechanics at the shop encountered these difficulties frequently.

The new wrench has a double jaw with teeth, made of tool steel, inserted and braised into the jaws of the wrench. This wrench saves time in adjusting the cam nut and eliminates purchases of additional wrenches to replace those with broken jaws. In addition, it eliminates a safety hazard—the possibility of skinned knuckles when the spanner type wrench slipped or broke.

ADJUSTMENT OF TRANSMITTING AND RECEIVING EQUIPMENT

The following, reprinted from a circular letter appearing in the Navy Department Bulletin, contains information pertinent to the operation of radio equipment. Personnel should acquaint themselves thoroughly with these provisions in order to obtain maximum performance of radio communication equipment.

1. The attention of the supervisory officers and radio personnel is invited to the dependence of communication efficiency upon the proper adjustment of radio transmitting and receiving apparatus.

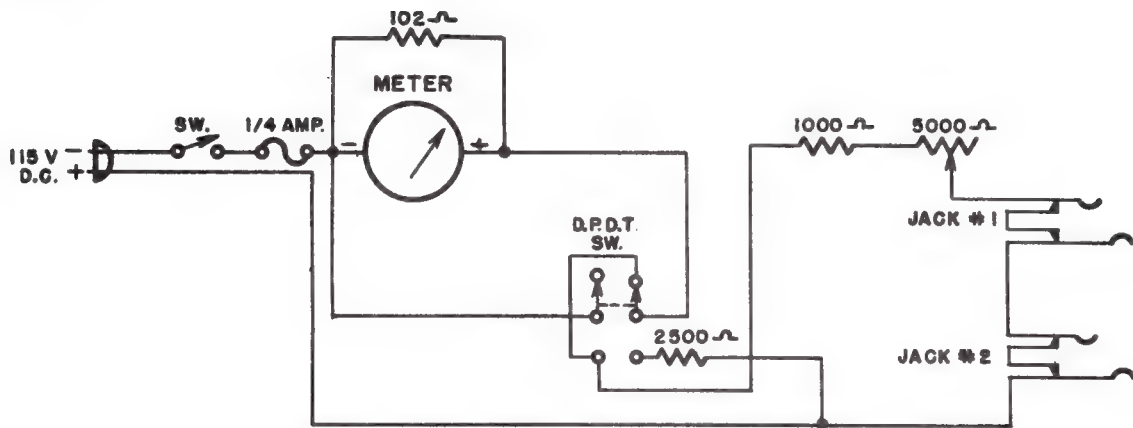
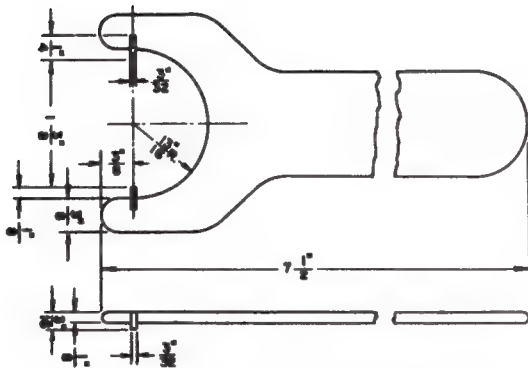


FIGURE 1



2. From a material standpoint, a radio communication channel may be considered to be efficient when—

(a) The transmitting equipment radiates on the exact assigned frequency just enough power to give an adequate signal to noise ratio at the receiving stations on the circuit.

(b) The receiving equipment continuously provides enough amplification and selectivity to permit the desired signals to be read by the receiving operators.

3. Transmitting equipment is frequently operated with power outputs far in excess of the requirements of the circuit. By reducing the radiation to the point where the requirements of paragraph 2 (a) above are satisfied, the following advantages are obtained:

(a) A substantial reduction in the amount of interference with adjacent radio channels and thus, aboard ship, an improvement in duplex operation.

(b) An increase in the security of communications due to a reduction in the effective range of the transmissions.

(c) A substantial reduction in the number of transmitter failures, which occur with greater frequency when

operating the equipment at or near its maximum rating.

(d) Economy in power consumption and components whose service life depends directly upon the time of operation and the power requirements.

4. There is a growing tendency among radio operators to adjust the receiving equipment to obtain such excessively loud signals that they have to remove the head telephones from their ears and wear them upon the cheek bones. They do this to relieve fatigue and protect their ears from sudden strong signals. The Naval Service generally does not appreciate the fact that such a practice prevents the full utilization of the capabilities of the receiving equipment and progressively lessens the skill of the radio operators. Similarly there has been a marked increase in the installation of one or more loud speakers in the same compartment, for the purpose of monitoring several different circuits. This practice contributes to the high room noise level and this in turn causes operators using head telephones to increase the signal level in the head telephones still further and also detracts from all the operator's ability to concentrate on the desired signal.

5. Tests with a large group of radio operators at the Naval Research Laboratory showed that a good readable signal (R-2) required only two thousandths of a volt across the head telephones when worn upon the ears but that five and a half volts were required to give the same readability when the phones were worn upon the cheek bones. The voltage for this latter condition must be, therefore, 2,750 times that required for proper operation of the receiver and is obtained by increasing the amplification by this amount. Since the available amplification may not be sufficient to give this high voltage across the telephones the operator will fail to hear a weak signal. If he does his hearing may have been so impaired or his training such that he will lack the ability to copy it.

6. The head telephones now supplied to the Naval Service are light and comfortable; fatigue due to weight and pressure has been reduced to a practical minimum. If the

audio output limiter now incorporated in new Naval receivers is properly and constantly used there should be no reason for the operators to be wary of sudden loud signals.

7. A little known characteristic of the human hearing mechanism is that the ability of the operator to discriminate between signal and noise intensities or between tones is much superior at *low intensities*. This means that the minimum amplification should always be employed whenever attempting to copy weak signals through comparable noise or interference.

8. During the earlier days of radio communications, when transmitters were relatively inefficient and receivers were incapable of high amplification and selectivity, skillful operators maintained excellent long range communication because they had developed their personal ability to overcome the handicaps of weak signals and interference. Modern apparatus has appreciably extended communication ranges but due to improper and careless operation these ranges have not been realized. The selectivity requirements due to decreased channel separation and duplex operation have been more than met by the provision of greater amplification and selectivity in modern receivers and an increase in the stability of the transmitting equipment.

9. The principal limit in transmitter efficiency and power output has already been reached. Future transmitter developments will include advances in stability, facility of adjustment and reliability. An actual reduction in power output and hence in range, especially on the lower frequencies, can now be expected due to mandatory decreases in antenna dimensions and the resulting increased difficulties with insulation and corona effects at high antenna voltages. The ultimate in receiver amplification has already been attained since it has reached the point where electron impacts in tubes and conductors can be amplified to high audio levels. Although efforts are being made to reduce these effects, it is now apparent that future improvements in receiving apparatus will mainly involve refinements in electrical and mechanical designs and not the provision of greater amplification.

10. It is therefore evident that future improvements in the efficiency of radio communication will depend upon the development of the skill of the operating personnel in their ability to hear and read weaker signals under more adverse conditions. The Bureau urges that supervision of radio communication be extended along the following lines:

- (a) Reduction of transmitter power to the minimum consistent with reliability.
- (b) Reduction of receiver amplification to levels usable with the head telephones worn upon the ears.
- (c) Continuous mandatory use of the audio output limited where provided.
- (d) Elimination of all loud speaker installations, used for radio communications, located in radio communication compartments.

TUNING TRANSMITTERS UNDER CONDITIONS OF RADIO SILENCE

Method

Up to the present time it has been possible to tune all

the stages of a transmitter under conditions of radio silence except the power amplifier and antenna circuits, but tuning these circuits has required the emission of power from the antenna.

A method has been devised for tuning all the stages of a standard communications transmitter without the necessity for radiation from the antenna. The system does not require any apparatus in addition to that already provided aboard ship. The radio technician should become familiar with the method. He may have to place equipments in operation whose antennas have been shot away, or damaged in some other way by the elements, in which case previous calibrations are of little value with the new antenna rigged to replace the original one.

With all antenna grounded and trunk openings in the radio room sealed off, the adjustment of the m-o and i-p-a stages to the correct frequency and to resonance can be checked with the transmitter in operation. At the same time the power-amplifier stage may be resonated, although antenna and coupling adjustments may subsequently necessitate readjustment of this stage. The transmitter is then shut down and the antenna connected to its antenna terminal.

Adjustment of the antenna circuits to resonance and determination of the proper coupling is accomplished by utilizing the static noise picked up by the antenna. A receiver tuned to the desired output frequency and lightly coupled to the transmitter p-a tube plate is employed to measure the noise level reaching this point. The noise level is indicated on a suitable audio output voltmeter connected to the receiver output. Circuit resonance is obtained by tuning the transmitter output circuits to produce maximum noise output from the receiver. Proper antenna coupling is determined by adjusting coupling and tuning controls until the receiver audio output voltage drops to about one-half when a resistor equal to the load resistance required by the power output tube is connected from the p-a plate to ground.

WARNING: Personnel are cautioned to exercise safety precautions and good judgment in carrying out the steps described in the following paragraphs.

Theory

The theory of operation can probably best be seen with the aid of an actual antenna circuit. (See fig. 1.)

The antenna can be represented as an inductance, a capacitance, and a resistance in series with a noise voltage, e_n , as shown in Figure 2.

By tuning the antenna circuit to resonance at the desired frequency, the simplified circuit shown in Figure 3 is obtained, where R' is a function of R_A and the ratio of L and C in the tuned circuit; e_i is the noise voltage at the desired frequency.

When the p-a tank circuit is tuned to resonance, the circuit simplified to a resistance R_2 in series with a noise voltage e_2 where R_2 and e_2 are both dependent on R_1 , e_1 , and the coupling capacitor. (See fig. 4.)

With the equipment operating normally as a transmitter the antenna reflects the proper resistance R_2 to the tube to

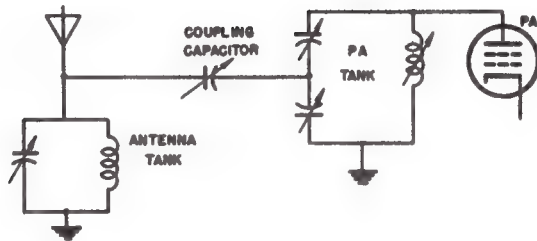


FIGURE 1.--Actual antenna circuit

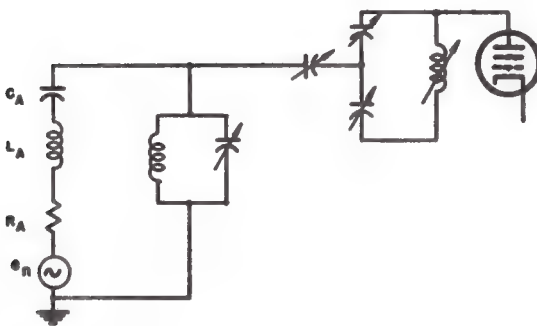


FIGURE 2.--Equivalent circuit of Figure 1

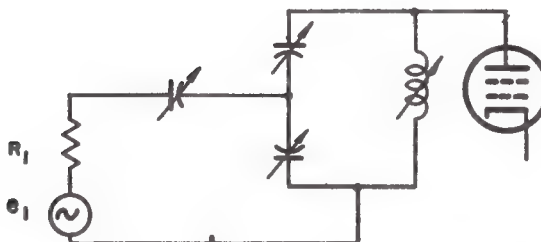


FIGURE 3.--Same as Figure 2, but with the antenna turned to resonance

provide proper p-a loading. If it is assumed that the proper resistance is R_L and is known, then the correct adjustment of the antenna tuning and coupling circuits which will make R_2 equal to R_L can be determined in the following manner. (See fig. 5.)

With the switch S open and the receiver tuned to the proper frequency, the gain control is adjusted to give a convenient value of a-c voltage. Closing switch S should now give a value one-half the previous reading if R_L equals R_2 . If the second reading is less than one-half, it indicates that R_2 is greater than R_L and the coupling must be increased. If the second reading is greater than one-half,

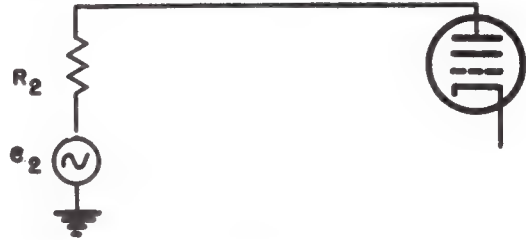


FIGURE 4.--Same as Figure 3, but with the tank circuit tuned to resonance

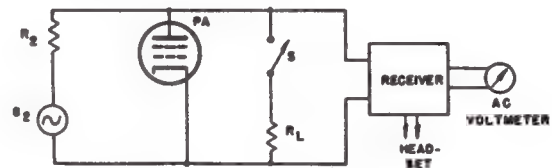


FIGURE 5.--Method of tuning

then r_2 is less than R_L and the coupling must be decreased.

The limitations of the method should be realized. For instance, when the noise level fluctuates intermittently it will be hard to make adjustments because of the unreliability of the output voltage from the receiver for various adjustments made during the procedure. However, antenna resonance can be quickly obtained and the degree of coupling between antenna and p-a tank can be approximated. Even if full power output is not obtained when the transmitter is used, sufficient power will be radiated, in all probability, to accomplish the desired communication.

Equipment Required

A good receiver with a *shielded* antenna lead, a one-half watt carbon resistor, and a fairly high impedance one- or two-volt a-c voltmeter are all that are required. The receiver must naturally cover the range of the transmitter. On the lower frequencies the length of the antenna lead is unimportant; however, above 10 mc the length should be kept to four or five feet or less so that it does not approach a quarter wavelength. A coupling capacitor is required as shown in Figure 6.

This prevents the capacity of the shielded line from detuning the p-a circuit. On the high frequencies, 2 to 18 mc, sufficient coupling may be obtained by twisting an inch or so of insulated wire around the p-a plate lead, while at the low frequencies, 175 to 600 kc, more capacity may be required, such as a 50- to 100-micromicrofarad mica capacitor. The coupling arrangement should be made so that it can be easily connected and disconnected. It also is important to have it arranged so that it is impossible

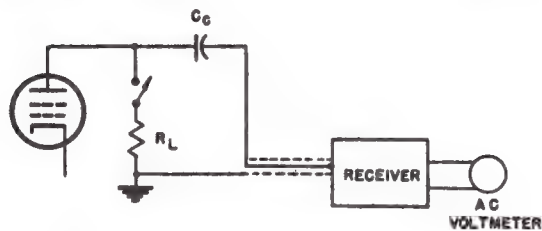


FIGURE 6.--Addition of a capacitor to Figure 5

to operate the transmitter with the receiver and resistor attached. It might be mentioned that it is necessary to hear the output of the receiver as well as see the noise voltage produced.

Determining Resistance R_L

Determination of the value of R_L (Figure 5) to use with any particular transmitter can best be accomplished when conditions permit operation of the transmitter into an actual antenna. If this course is not permissible, a determination can be made if the transmitter can be fed into a dummy antenna, or if a careful calibration of the transmitter with its antenna is available for any frequency. The values in the table at the end of this assignment can be used if time and circumstances do not permit an individual check on the ship's transmitters.

In those instances where the emission of power is permissible the proper value of resistance for R_L can be determined as follows:

- (1) Tune the transmitter to any frequency and load the power amplifier to the proper value.
- (2) Tune the receiver to the frequency of the transmitter.
- (3) Shut down the transmitter and couple the receiver to the p-a stage as described in the preceding paragraphs.
- (4) Try connecting different values of resistance from the p-a plate to ground until the audio noise voltage obtained with the resistor is one-half of that obtained without it.

Step (4) can be accomplished with greater ease and accuracy if a signal generator such as a model LP is tuned to the same frequency and connected to a wire near the antenna. This produces a steady mcw signal to work with rather than the more erratic static noise.

In those cases where emission is not permissible, the transmitter may be set to any previously calibrated frequency and steps (2) to (4) of the preceding paragraph followed. The LP, of course, cannot be employed under these conditions.

Tuning the TBK During Radio Silence

- (1) With all antennas entering the transmitter room grounded and all trunks closed, start up the transmitter and tune all stages to resonance, including the power amplifier.

- (2) Tune a receiver of approved low oscillator radiation to the transmitter output frequency, being careful not to damage the receiver. Connect an audio voltmeter with about a one-or two-volt range to the output of the receiver.

- (3) Shut down the transmitter and connect it to the antenna.

- (4) Make sure that the voltage is actually removed from the power amplifier by using a discharge probe, shorting it to ground momentarily. Couple the receiver to the p-a tube plate by wrapping two or three turns of insulated wire around the plate lead. (A more permanent method of coupling can be devised when time permits so that the receiver may be readily attached or disconnected.) The receiver antenna lead should be a four-or five-foot length of shielded wire.

- (5) If calibrations are available for the transmitter with the particular antenna, set the antenna controls to the positions indicated for the nearest frequency. If no calibration is available for a frequency reasonably close, set the coupling control at mid-scale and proceed.

- (6) With the receiver AVC off, tune the p-a tank circuit until maximum noise output is obtained from the receiver. The correct point is usually quite sharp.

- (7) Connect R_L from the plate of the p-a tube to ground. Then adjust the antenna tuning circuit for maximum noise. The correct point may not be sharp and will require later adjustment. Do not change the coupling adjustment.

- (8) Remove R_L and adjust the receiver sensitivity to give an output of one volt or some other convenient value on the audio output meter.

- (9) Connect R_L from the plate of the p-a tube to ground and note the receiver output voltage. If it is near one-half volt (or half value), the loading is nearly correct. Care should be taken in obtaining the readings to get the average noise voltage and not the peaks.

- (10) Closer resonance of the antenna circuit can now be obtained by shifting the antenna tuning dial a few divisions in one direction and repeating steps (8) and (9). If the ratio of voltages increases over that previously obtained, try a few more divisions and repeat the process until a maximum ratio of "voltage with R_L in to voltage with R_L out" is obtained.

- (11) If the final ratio of step (10) is greater than 0.5 (or a previously determined value), the coupling is too tight and should be decreased. If the ratio is less than 0.5, the coupling should be increased.

- (12) If the coupling is changed appreciably, repeat steps (6) to (10) until the final ratio of voltages is correct.

- (13) Since the possibility exists that exact resonance will not be attained and the p-a may overload when an attempt is made to put the transmitter on the air, it is suggested that the p-a plate voltage be decreased about 25 percent to preclude operation of the overload relay. Any necessary trimming adjustments can be rapidly made and the power increased to normal during the first few moments of operation.

Notes

Reference to the transmitter instruction book should be made in the case of all intermediate frequency equipments

to determine whether the power amplifier is adjusted for maximum output as a final step. On most transmitters in the 175-600 kc range, this is not the case and the p-a tank should not be returned after setting it to initial resonance. Whichever the procedure, the instructions should be followed in making the adjustments with the receiver. Since the intermediate-frequency equipments such as the TAJ and TAQ work only with capacitive antennas, the antenna tuning and coupling system is considerably simpler and rapid adjustment is possible. With any transmitter, care should be taken to follow step (10) of the above procedure very closely, since the correct resonance point of the antenna circuit cannot be determined by step (7) alone. Since the final result depends on the receiver output being proportional to the applied static voltage, it is important that overload of the receiver be avoided.

Considerable improvement in accuracy can be attained after a few trials; therefore, it is suggested that personnel take every opportunity to practice the procedure when conditions permit operation of the transmitter to check the results.

The following values for R_L were found to be approximately correct for the transmitters listed below. Resistors were of the half-watt IRC metallized variety.

TBK (Westinghouse)	5000 ohms
TAJ (Westinghouse)	5000 ohms
TBL-4 (RCA)	2800 ohms (If and HF)
TAQ-5 (GE)	1000 ohms
TCK (GE)	2200 ohms

SPURIOUS RADIATIONS WHILE TUNING TRANSMITTERS

There is a possibility of spurious radiations being emitted, unintentionally, during transmitter tuning processes. Such radiations would have two main sources:

- (1) If the transmitter oscillator is operating, then judgment must be exercised to ascertain that there is no form of coupling between this oscillator and the antenna.
- (2) If a signal generator is connected to a receiver antenna trunk for the purpose of checking the receiver frequency, or for any other purpose, then radiation from the signal generator will occur.

Elimination of these radiations may be accomplished as follows:

- (1) It is feasible to tune the transmitter completely without radiating. A suitable method is described in the article "Tuning Transmitters Under Conditions of Radio Silence."
- (2) Elimination of radiation from signal generators is simply a matter of refraining from coupling the antenna to a signal generator during radio silence. To insure that coupling does not exist, it may be useful to seal off the receiver antenna, and to use a direct connection to the receiver instead of a radiating connection because of the possibility of pickup of this radiation by other antennas.

HOW TO LOAD THE TRANSMITTER

The material to follow is published for the instruction of those members of ships' personnel who are not entirely familiar with the tuning of transmitters.

An antenna will not radiate all the power available from the transmitter unless the impedances of the antenna and transmitter are properly adjusted by a method of "loading". Loading generally consists of two parts: The tuning of reactances which are connected to the antenna for the purpose of changing or "transforming" the impedance of the antenna; and the adjustment of coupling reactances which are connected between the transmitter and the antenna loading reactances.

The tuning procedure almost always starts with the loosening or decreasing of the coupling in order to protect the transmitter. This is necessary because overcoupling of the tuned antenna might reduce the impedance of the final stage's tuned circuit to such an extent that the final stage tube would conduct an unsafe amount of current.

After decoupling, the final stage is tuned. This process usually involves tuning a parallel resonant circuit which is in series with the plate of the output tube. The tuned circuit is the load impedance for the output stage and is tuned to parallel resonance by rotating the condenser and observing the final plate current meter (or cathode current meter). When it reads a minimum value, the plate load impedance has been maximized and is correctly adjusted.

Next, the antenna is tuned so that it will draw a maximum amount of power from the transmitter. This is done by varying the loading reactances as described in the instruction book, meanwhile observing that the antenna ammeter indicates in a manner described in the article "What Does Antenna Current Mean," with the magnitude of the current dependent upon the adjustment of reactance described in this paragraph. When the adjustment is correct, the antenna ammeter will indicate a maximum current (providing such current is readable) and the final stage plate current will also reach a maximum. In other words, the tuning apparatus is adjusted until these two meters indicate maximum value.

At this point in the adjustment schedule, the coupling apparatus is still arranged for loose coupling. The last step is therefore a tightening of the coupling, accomplished by closing the plates of a coupling condenser, or by bringing the two windings of a radio-frequency coupling transformer closer together. The proper degree of coupling is obtained when the plate current meter of the final stage indicates the rated value, or that value of current which the instruction book describes as "rated" or "normal".

If the frequency establishes enough current in the antenna standing wave at the antenna ammeter to permit an ammeter indication, then the antenna current can be observed during the coupling process. Usually, the antenna current will rise as the coupling is tightened (increased), but, of course, the operator ceases to increase the coupling when the final plate ammeter shows rated current.

Sometimes, usually at high frequencies, the instruction book mentions overcoupling. In such cases, the rated value of plate current is reduced from its usual or normal value so that the tuning may be accomplished by observing the final plate ammeter. In such cases, if the antenna current can be observed it will rise during the tightening of coupling until the plate current reaches rated value, and

will then decrease if the coupling is tightened enough to draw more than rated final plate current.

Summary: Loading is almost always accomplished with these several simple steps:

- (1) Decrease coupling.
- (2) Tune final plate circuit to the dip in plate current.
- (3) Tune antenna circuit to maximize final plate current. (Antenna ammeter will pass through a maximum reading, which may be too small to see.)
- (4) Increase coupling until final plate ammeter shows rated current. (Antenna ammeter will again increase, but may not be large enough to observe.)
- (5) If the coupling cannot be satisfactorily decreased for step (1), then it may help to disconnect the antenna, and reconnect it between steps (2) and (3).

There are frequent reports of difficulties in properly loading transmitters on certain frequencies. On a few transmitting equipments the output coupling devices do not have sufficient range to load the antenna with the above procedures. The trouble can usually be cleared up by adding a controllable amount of reactance to the antenna circuit, either inductive or capacitive reactance being used as required. It has been found that a 250-mmfd. variable condenser suitably mounted and protected is usually all that is required. A type 481640 auxiliary tuner has been developed by the Bureau to eliminate tuning difficulties with the model TCE series transmitters. These tuners consist of a 250-mmfd. condenser suitably enclosed for mounting either on a bulkhead or atop the TCE, and may be secured by request through the normal supply channels.

QUICK NEUTRALIZING TESTS

Transmitters that are on the air for long periods of time, or continuous 24-hour operation, can be checked for neutralization while operating. This is accomplished by tuning the plate controls slightly off resonance and observing the action of the grid meters. This procedure is based on the assumption that the circuit is operating as a pure amplifier, with the deviation from normal readings indicating some irregularity. It also assumes that the Q of the circuit is constant over the tuning range. Theoretically the Q is constant for only one frequency in a given circuit; however, for the small tuning change the Q is virtually the same.

Figure 1 illustrates the condition under investigation while tuning the r-f amplifier. At "A" is a block diagram of a neutralized amplifier, the r-f input to the grid circuit alone being used to obtain the power output. Almost the same condition exists at "B" of the same figure, an r-f oscillator. It is merely an r-f amplifier with some of its own plate power fed back, usually in the neighborhood of 5 percent of the output and in the proper phase for sustained oscillations. Thus in the grid circuits of "A" and "B" only one r-f current flows to vary the bias voltage. In "C" of figure 1, we have the case of the unneutralized amplifier, where r-f is fed from a preceding stage, but some r-f is also fed back from a spurious frequency in the plate circuit. This is really a combination of an r-f amplifier and

an oscillator that results not only in poor efficiency but also produces undesirable frequencies.

In the cases illustrated at "A" and "B", an ammeter in the grid circuit will show the current flowing during resonance, and this current will fall off in about the same degree either side of resonance, as illustrated by curve "AA" of figure 2.

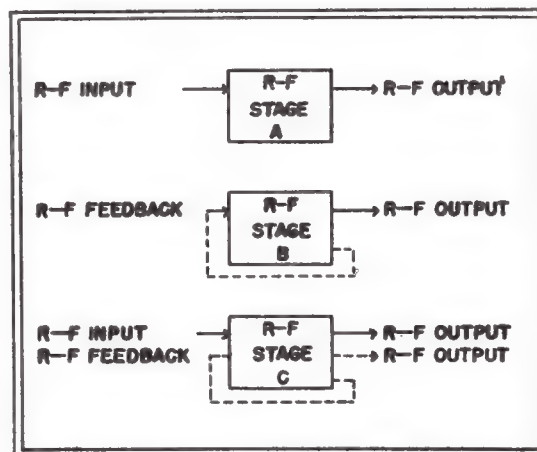


FIGURE 1.--Typical conditions of operation of an r-f amplifier stage in a transmitter.

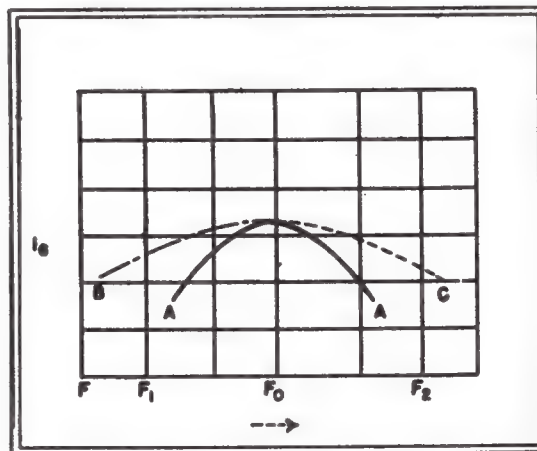


FIGURE 2.--Graph showing the possible changes in the grid current of an r-f amplifier when the plate tank circuit is tuned through resonance

Some operators prefer to watch the plate and grid ammeters at the same time, the one rising and the other falling about the same degree either side of resonance. However, in tightly coupled circuits, especially at high frequencies, these two relationships may not hold even though the amplifier is perfectly neutralized.

When another current is present in the grid circuit due to extraneous oscillations, the current will not fall off at the same angle, but one side will have a steeper dip than

the other. Thus, if in tuning from F_0 to F_1 and F_2 , the curve "AC" results, it may be an indication of unbalance, possibly caused by bad neutralization. Curve "AC" might indicate instability at frequencies above resonance, which would call for reduction of inductance (in inductance neutralization). Curve "BA" would show possible instability below resonance, requiring more inductance or capacitance in the neutralization circuit.

While this system may indicate an unbalance in the tank circuit, it is not to be used to obtain neutralization. Even if an unbalance is noticed, it is no assurance that the circuit is not neutralized. Furthermore, only operators thoroughly familiar with their transmitters should use this method, since off-resonance operation can raise the plate current to the point where the overload circuits would operate. It would then be difficult to bring controls back to normal to get the transmitter back on the air. Observing the grid ammeters should be used only to determine normal conditions, with any unusual changes warning the operator of some kind of irregularity.

Another way of checking neutralization rapidly is by cutting off excitation. (This may require recording a carrier break in the transmitter log.) This is done by shutting off the auxiliary oscillator's plate supply and then switching the oscillator transfers switch to the dead oscillator, killing the r-f supply to all succeeding tubes. If the tubes are all biased to cut-off or beyond, the grid and plate ammeters should all drop to zero in a perfectly neutralized transmitter and the carrier should go off the air. Any flow of plate and grid current will indicate possible oscillation in the earliest stage and should be checked through the regular neutralization procedures.

This process of checking takes only a couple of seconds, long enough for the technician to observe that the particular ammeters read zero, while plate and grid voltmeters remain at normal readings. Amplifiers with self-bias are so biased that, with all excitation removed, a safe amount of plate current flows. Such a stage would seem to have regeneration or oscillation, but the skilled technician will be familiar with his circuits.

Where plate current flows with excitation off, the difficulty may be traced not only to improper neutralization but to spurious oscillations, caused generally by similar r-f chokes resonating in the plate and grid circuits at some far removed low frequency. Parasitics of high frequency due to long r-f leads may also cause irregular operation and may show up with this check.

If the operator has more time available and his transmitter is off the air he has two other easy ways of checking roughly for neutralization. With the filament of the amplifier tube lit, but the plate voltage off, r-f voltage is fed to the amplifier. While observing the grid current meter, the plate tank tuning capacitor is rotated through resonance (with no plate voltage). In a perfectly neutralized stage, the grid ammeter reading should remain steady, since the plate circuit is supposed to have no reaction upon the grid circuit.

In a badly neutralized stage, there will be a violent dip of the grid meter while tuning through resonance. There will generally be some slight reaction on the meter,

especially on the higher frequencies, even through the amplifier is neutralized, but the operator will easily recognize this flutter of the needle from the more pronounced dip caused by poor neutralization.

Another quick check is good for all but the final stage. This requires that two stages have no plate voltage while checking, although the filaments remain on. With a preceding stage tuned to resonance (but no plate voltage) the succeeding amplifier is likewise tuned to resonance and its plate meter observed for current. The presence of current will be a fairly sure sign of RF leaking through the preceding amplifier tube and being rectified in the succeeding stage.

Obviously the final stage cannot be checked in this manner since there is no following stage in which to detect the presence of RF. At higher frequencies or due to stray couplings, some RF may still feed through but the engineer is conscious of these peculiarities.

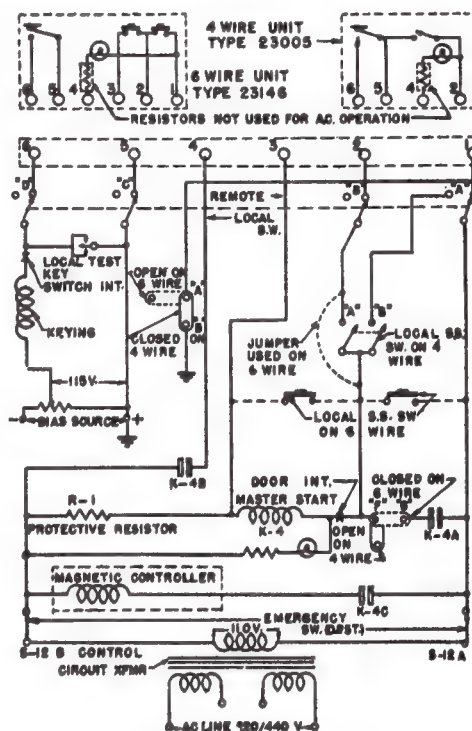


FIGURE 1.--Basic standard 4- and 6-wire remote control circuits for transmitters having a-c. supplies

It must be stressed that the technician must be fully acquainted with the circuits he tests by these methods, to avoid damage and trouble. These checks should serve to indicate that everything is operating normally; any deviations from usual readings only warning the operator that more careful checking is needed. Even after these tests have been completed, there may be extraneous oscillations due to shock excitation, transients, or other strays developed by long operation of circuits, which will escape notice. Such special conditions require treatment with extensive and elaborate equipment.

TRANSMITTER CONTROL CIRCUITS

The transmitter control circuit diagrams which follow were prepared by the staff of the Radio Material School, Naval Research Laboratory. They are simplified schematic diagrams of the starting, stopping and keying circuits for various Navy transmitters. It is not intended for them to be complete schematic diagrams of the entire equipment, but it is believed that they will be a help toward the understanding and servicing of the control circuits of Navy transmitters.

Figure 1 shows the basic standard four- and six-wire remote control circuits for transmitters having a-c. supplies. Figure 2 shows the same circuits for transmitters having d.-c. supplies.

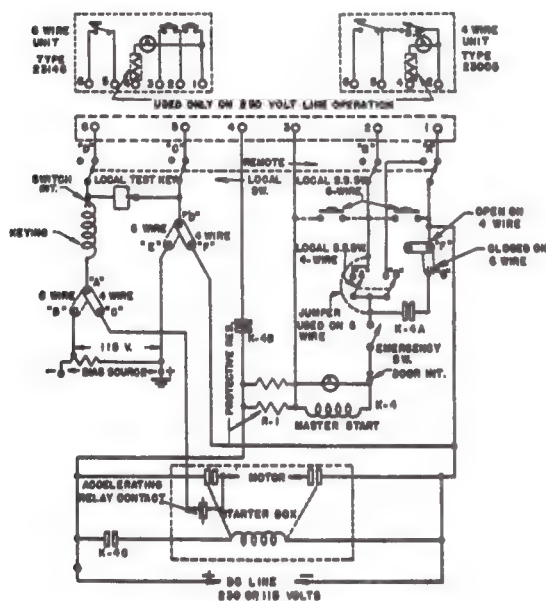


FIGURE 2.--Basic standard 4- and 6-wire remote control circuits for transmitters having d-c supplies

TRANSMITTER MONITOR

A simple monitoring device has been designed by John Tocarsic, CTC, and adopted by the Naval Radio Station at Annapolis. Designed for use with the model TEF single-side band transmitter, but adaptable to other models, it shows continuously whether the transmitter is on or off the air. Without its use, the operator at the transmitter must depend on the operator at the receiving station for notification of failure.

The monitor consists essentially of a tuned-circuit loosely coupled to the antenna transmission-line, a diode-connected detector, two neon lamps, and associated components and wiring. With r-f signals of sufficient amplitude in the tuned circuit, the lamps will glow.

Figure 1 shows the monitor as designed for use with the model TEF transmitter. The four-position switch selects the pre-set trimmer capacitor resonant with L, at

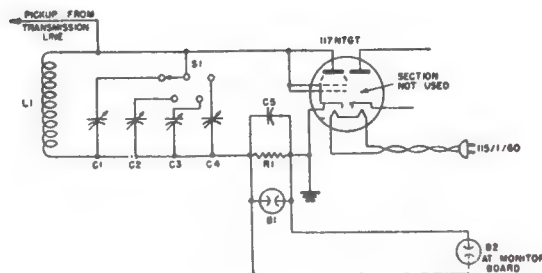


FIGURE 1.--Transmitter monitor

the carrier frequency being used. The rectified output voltage across B₁ and B₂ is sufficient to light the lamps unless the TEF power output is below normal.

Although this monitor was designed for use with the Model TEF equipment, it can be readily adapted to any radio transmitter. The trimmer capacitors must, of course, be resonant at the transmitter frequencies being used, and the degree of r-f coupling to the monitor, depending on the individual installation and the power output of the transmitter, must be determined by experiment.

Symbol in figure 1

Symbol in figure 1	Component
L ₁	3½ turns No. 20 enameled wire.
S ₁	4-position frequency selector switch.
C ₁ , C ₂ , C ₃ , C ₄	0.00014 μf trimmer capacitors.
C ₅	0.001 μf paper, 600 volts.
R ₁	1 meg., 1-watt carbon.
B ₁ , B ₂	115-volt neon lamps.

4/1/48

EMERGENCY FREQUENCY CONTROL

There are many occasions in field operations or at advanced base radio stations when there is a need for a stable, continuously variable means of frequency generation to drive a normally crystal-controlled radio transmitter. Changes in communication plans at the last moment will render a transmitter idle until crystals of the proper frequencies are obtained or reground to the redesignated channels. The allowance lists for advanced base stations usually contain a few Navy type LM frequency meters. Similar types such as the Army SCR-211 may also be obtainable. One of these units may be used as a variable frequency oscillator by connecting it to a fabricated exciter, the circuit of which is shown in Figure 1. This arrangement will deliver approximately eight watts output. All screen and plate resistors are ten-watt types. Key the first 6AC7 when using it as a variable frequency oscillator. Crystal control may be obtained by connecting the crystal across the second 6AC7 as shown in the diagram. Keying is then accomplished in the second 6AC7.

The output of the exciter may be connected directly to the grid of the isolation stage or doubler. When the transmitter is equipped for a frequency-shift keyer, the output may be plugged directly into this receptacle.

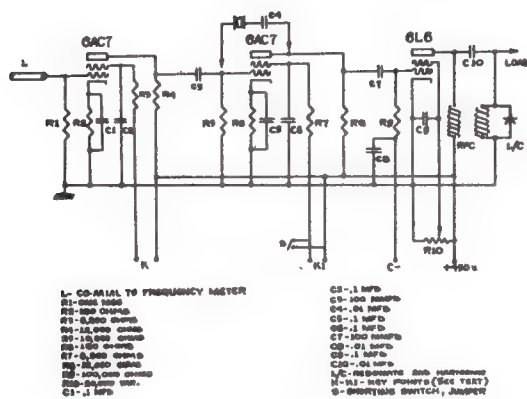


FIGURE 1.--Continuously variable master-oscillator arrangement

FAILURE OF LOW-FREQUENCY A-C AND D-C TRANSMITTER METERS

Transmitter meters frequently are shunted by a small condenser to protect them from high r-f currents. In case of burnout, test this condenser before replacing the meter and replace the condenser if it is found to be faulty. It may be well to replace this condenser with one of a higher voltage rating if the original has failed and it may be helpful to substitute one of higher capacitance if the original is still good, but of insufficient capacitance to protect the meter.

ERRATIC PERFORMANCE OF VHF EQUIPMENT

One cause of erratic performance in VHF equipment has been rain entering the microphone. A thin rubber cover has proven satisfactory for keeping the microphone dry, and does not interfere with normal operation of the equipment.

RADIO FREQUENCY TRANSMISSION LINE RG-128/U

The new 1-5/8 inch air dielectric rigid coaxial line RG-128/U is now available through the Electronics Supply Office. The available components are listed following and shown in figures 1-4. Figure 5 shows typical components as arranged in an installation. Each 20 foot section of the RG-128/U is shipped with installation instructions. This 1-5/8 inch line is not interchangeable with other types of 1-5/8 inch lines. The dehydrator system shown in figure 5 should be used unless a dry and oil free low pressure air supply is available from another central source.

Type	Description	SNSN
RG-128/U	Coaxial Line, 20 foot sections with connectors attached	N5985-049-8585

Type	Description	SNSN
UG-677/U	Connector Set, consisting of male and female fittings and bullet. See fig. 1	N5935-377-6877
UG-965/U	Adapter. See fig. 2	
UG-676/U	Elbow. See fig. 3	N5985-387-2786
MX-1228/U	Seal. See fig. 4	N5985-284-6488

The RG-128/U cable is not to be used unless specified on BuShips installation plans. Radio Set AN/URN-3 for shipboard installation is the only equipment at present with plans showing the use of RG-128/U.

NOTE: Figure 5 in the EIB No. 382 article should indicate connection of the Expansion Dry Air Unit CAKB-100 to Ships Low Pressure Air System instead of High Pressure Air System.

INSULATOR MAINTENANCE

One attribute of efficient transmitter operation is the high insulation resistance of its associated insulators. A periodic megger test of the insulation resistance to ground provides a method of determining if this condition exists.

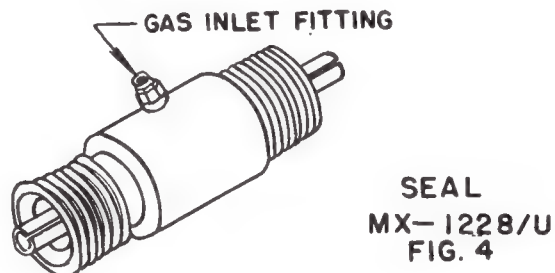
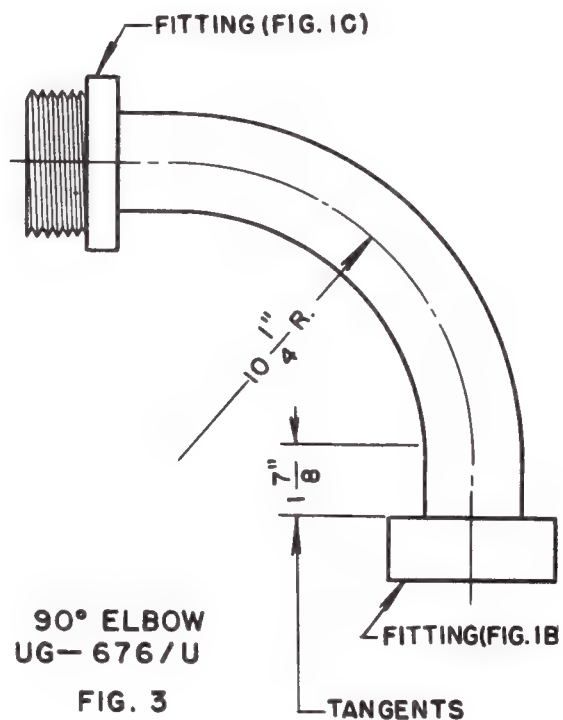
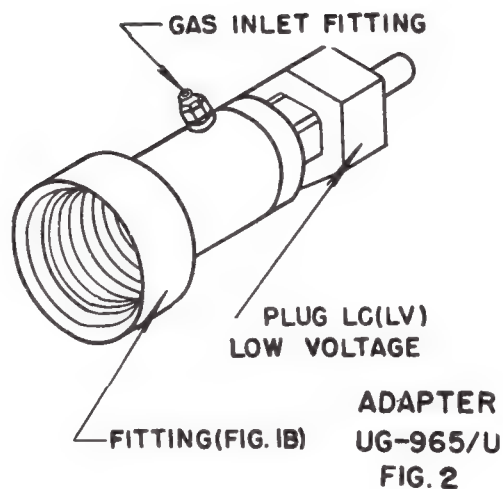
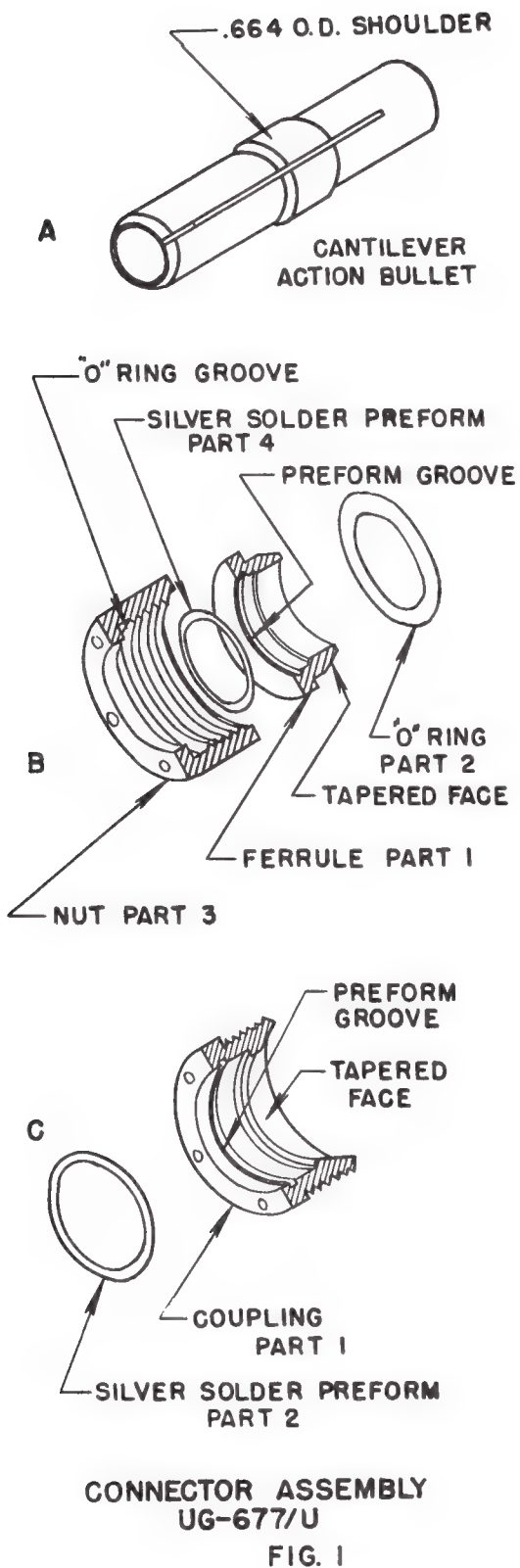
The following values provide an indication of expected radio antenna performance: (1) A resistance of 100 megohms or more to ground indicates that an antenna is in good condition. (2) A resistance of from 35 to 100 megohms to ground indicates that the insulators need cleaning. (3) A resistance of less than 35 megohms indicates a defective insulator. Determine the cause and remedy before resuming operation.

Clean all stand-off insulators, end-seals of transmission lines and wave guide windows at least once a month. Maintenance becomes increasingly important as the size of the units decrease. Aboard submarines, clean these equipments as soon as possible after surfacing.

Use this cleaning method: Wash the insulator with fresh water or with a dishwashing compound in a solution of hot water until all accumulated dirt and salt water deposits are completely removed. Then dry thoroughly and with a clean rag apply a thin, even coat of Dow-Corning Compound No. 4 on the entire surface of the insulator. This compound forms a film which sheds water, greatly reducing the formation of salt water deposits and the accumulation of dirt.

WRENCH FOR TELETYPE TRANSMITTER DISTRIBUTOR

A new type wrench (See illustration) for adjusting cams on teletype transmitter distributors has been suggested. This wrench is now in use at Shop 67. Previously, a single jaw spanner type wrench was used for this purpose but it proved inadequate. The cam adjusting nut was so thin that it necessitated the use of a thin wrench with a very small jaw or tooth to fit the slot in the cam nut. When pressure was applied to the wrench, if too great a resistance was met, the wrench would either slip from the nut, or the tooth of the wrench (being its weakest part) would



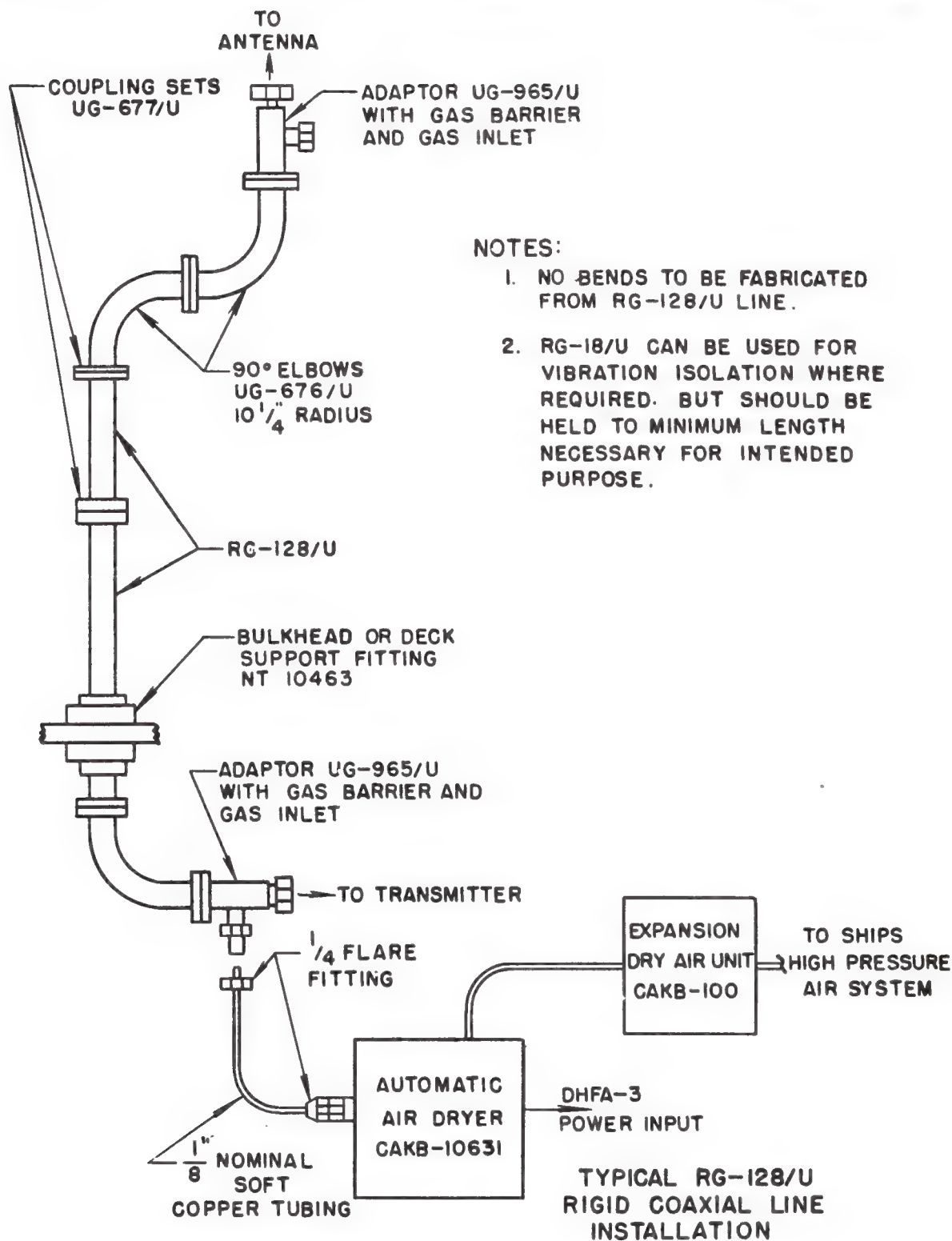
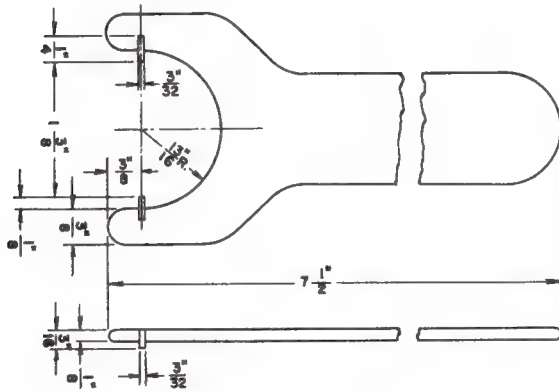


FIG. 5

break off. Mechanics at the shop encountered these difficulties frequently.

The new wrench has a double jaw with teeth, made of tool steel, inserted and braised into the jaws of the wrench. This wrench saves time in adjusting the cam nut and eliminates purchases of additional wrenches to replace those with broken jaws. In addition, it eliminates a safety hazard—the possibility of skinned knuckles when the spanner type wrench slipped or broke.



BELL CRANK LOCKING TOOL FOR PRINTER REPERFORATORS

A "tool" to support and lock the vertical bell cranks during repair of a typing reperforator is in use at the Long Beach Naval Shipyard.

The locking bracket "tool" is designed to support the vertical lever bell cranks when the vertical levers are removed, and to prevent them from slipping while re-installing the levers. It also facilitates reassembling of the punch bail bell assembly because the punch bail assembly is not free to move.

Figure 1 illustrates the application and figure 2 provides construction details of the tool.

STANDARD 807 TUBES FOR SHORE STATION TRANSMITTERS

Numerous Shore station transmitters, which require type 807 electron tubes, cannot use tube types 807W, 5933 or 5933WA as high reliability replacements. This is due to the larger base diameter and shorter body of the reliable type tubes which make it impossible to install them in the older equipment which use sub base mounting of 807 sockets and short plate leads.

ESO supply activities have been issuing the reliable type tubes for all requisitions requesting 807 type tubes. This has often resulted in attempts to modify the equipments to accommodate the reliable tubes. Modification is neither recommended nor authorized. As many Shore station transmitters use large numbers of the 807 type tube, the total cost of modifying all equipments would be excessive, and in many instances technically undesirable.

ESO supply activities will establish and maintain a stock of standard 807 tubes. Mark requisitions for standard 807 tubes "DO NOT SUBSTITUTE". Reliable type tubes

will be supplied on requisitions which make no specification.

RIGGING OF WIRE ROPE ANTENNAS

A "losttime" accident which occurred during the installation of a wire rope transmitting antenna, caused by failure of a NT61493 strain insulator has been reported. Subsequently, during a test of 87 of these insulators 12 failed under a strain of 500–3000 pounds although the minimum breaking strength is specified at 3500 pounds. This accident points up the necessity for installation safety links in accordance with BUSHIPS DWG RE 10C 2112 and the need for care in making the actual installation.

The illustration shows a method for computing the strain on an antenna wire, which has been used for years by Newport News Shipbuilding and Drydock Corporation. Note that the figure gives the strain on the antenna insulators when subjected to an 108 mile per hour wind. If during installation this antenna had been set to a 945 pound tension in still air the sag would have been about .5% and when subjected to an 108 mile per hour wind the strain would become 4700 pounds. BUSHIPS recommends initial installation of wire rope antennas with approximately 2.5% sag.

INTERFERENCE FROM CEASE FIRE SIGNAL SYSTEM, CIRCUIT "4U"

There have been occasional reports of radio interference to communication receivers, originating in the cease firing signal system. This interference usually centers in the 4 to 27 mc range. The source of interference is often the motor operated contact maker, type K-2, generally located in the I. C. room. The interference generated at the arcing contacts is conducted via ship's cables and radiated to communication receiving antennas.

The installation of a 100 ohm resistor in series with a 0.1 mfd capacitor across the motor driven contracts will substantially reduce, if not eliminate, all interference from this source.

Another source of interference in the cease firing circuits has been the type IC/H8S4 and IC/H8D4 (old type H9) motor driven horns. These horns are manufactured by Federal Sign and Signal Corporation (formerly Federal Enterprises, Inc., and Federal Electric Company) and the Benjamin Electric Company.

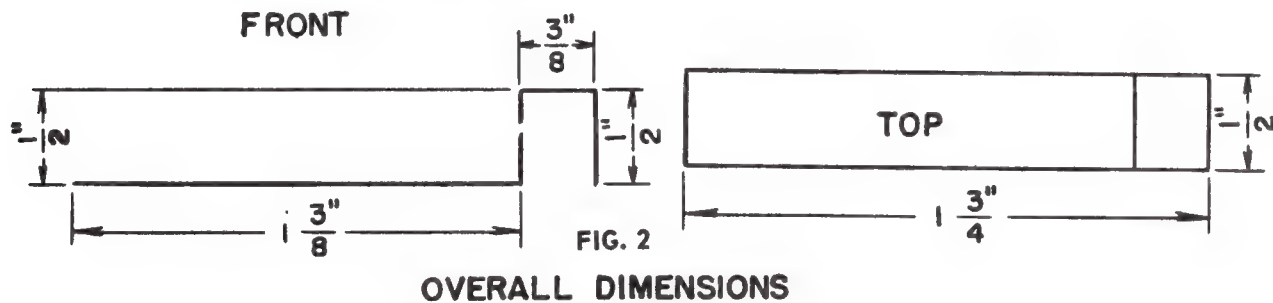
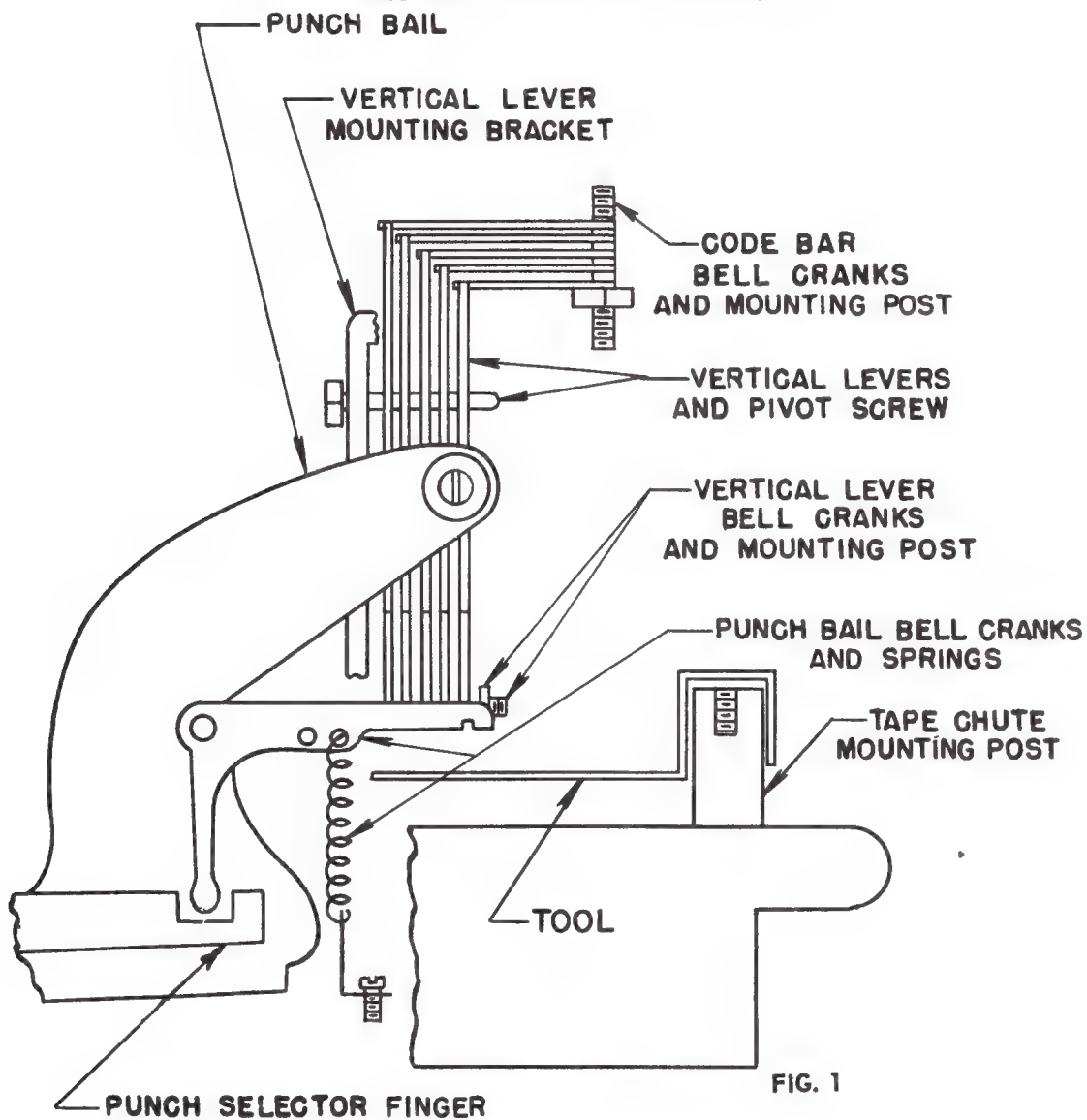
Filter units specifically designed to eliminate this interference are available and should be used where interference of this nature is objectionable. These filters are not a Federal Stock item and must be obtained through outside purchase from Federal Sign and Signal Corporation, Chicago, Illinois (Federal Horns) and from Sprague Electric Company, North Adams, Massachusetts (Benjamin Horns).

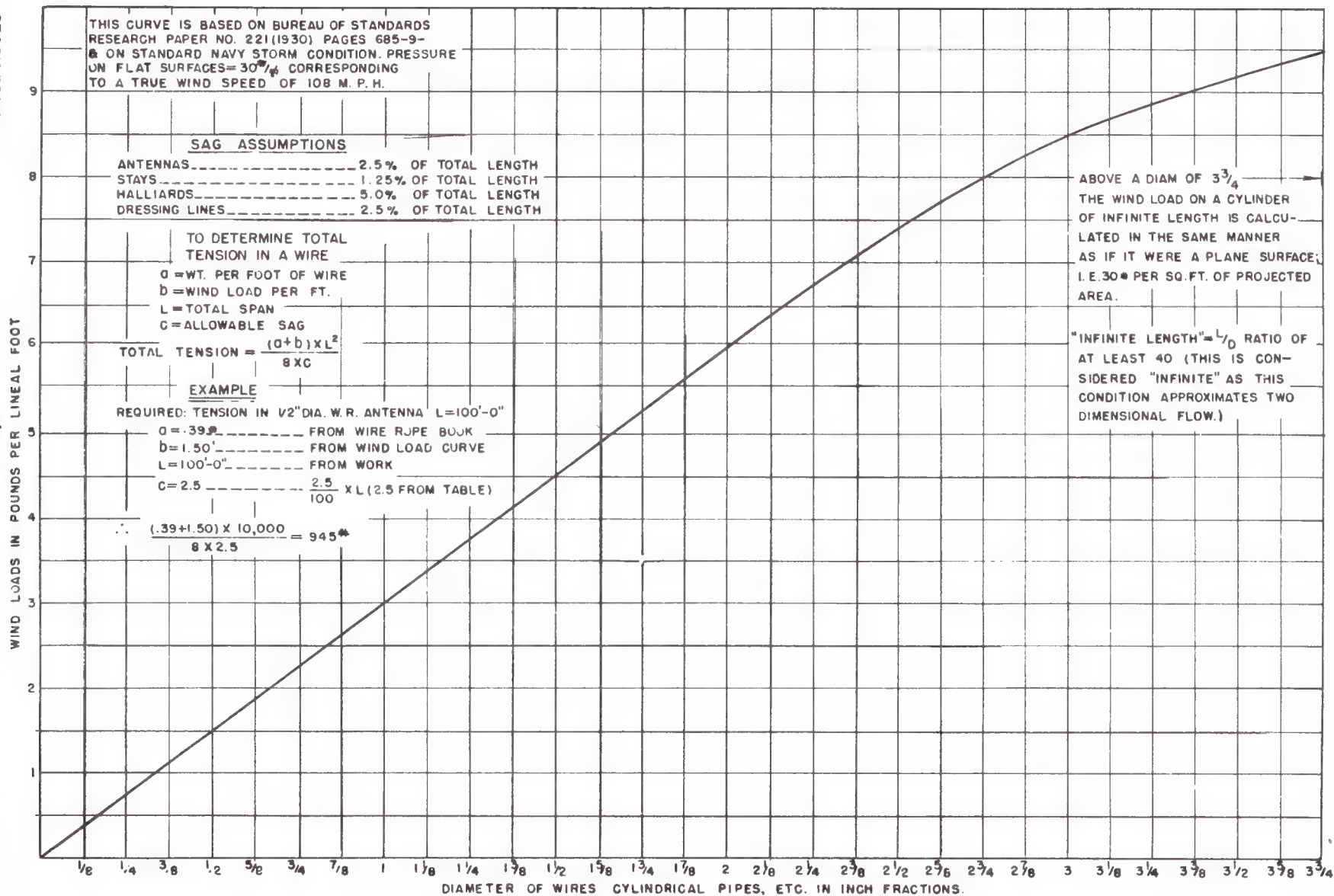
A development of the type IC/H8S4 and IC/H8D4 horn incorporates a filter within the horn enclosure.

DO NOT INSTALL UHF AND VHF ANTENNAS IN THE SAME HORIZONTAL PLANE

Installing an antenna designed for 115 to 156 mc operation at the same elevation (in the same horizontal plane)

FRONT VIEW SECTION OF TYPING REPERFORATOR AND APPLICATION OF "TOOL"





as an antenna designed for 200 to 400 mc operation will likely cause a null in the radiation pattern of the UHF antenna. The quarter wave rods of the VHF antenna are half wave at UHF frequencies.

CABLE CLAMP FOR TELETYPEWRITER EQUIPMENTS

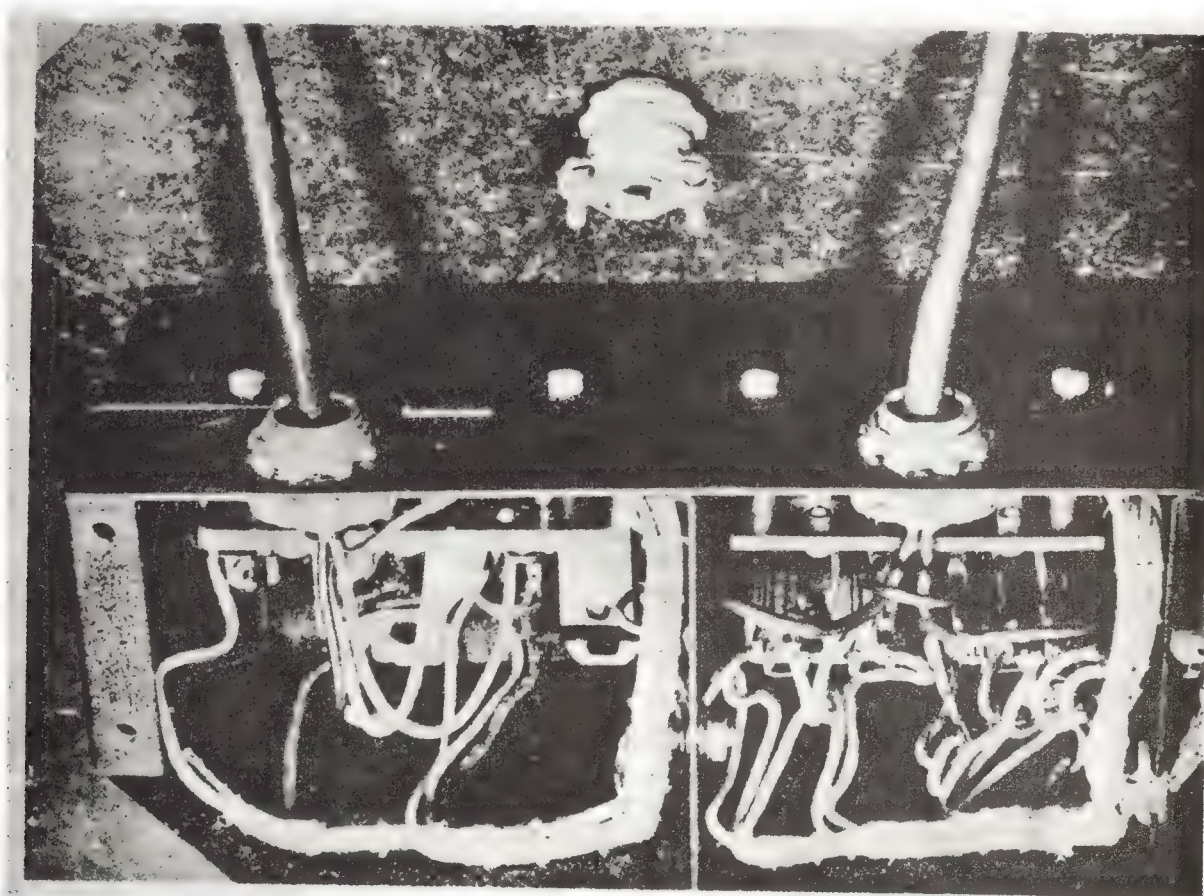
The use of a cable clamp at the service assembly entrance of teletypewriter equipment has been suggested.

Present commercial installation drawings specify the use of Teletype Corp. Part No. 125-208 Nipple and Part No. 125-209 Nut where cables enter the service assemblies. The nipple does not secure the cable mechanically,

which is undesirable in shipboard installations since it leaves only the electrical connections to hold the cable.

The cable clamp suggested (Teletype Corp. Part No. 97487 FSN N5815-369-8958) has a threaded portion by which it can be mounted through a panel. The clamp portion provides a firm mechanical connection and prevents withdrawal of the cable. The illustration shows the cable clamp installed.

This method is particularly applicable to the service assemblies off TT-7/F, AN/FGC-9, AN/FGC-11, AN/SGC-2 and Teletype Corp. Model 19, equipments.



RF TRANSMISSION LINES BETWEEN UHF TRANSMITTERS, RECEIVERS, AND MULTICOUPLERS

Some misunderstanding is evident in regard to the length of the RF transmission line between the various UHF transmitters and receivers and the Antenna Couplers CU-25/UR or CU-332A/UR. Preliminary instruction books erroneously specified these RF feed lines as "RG-10/U, 15 feet minimum." This was changed in the final book, NAVSHIPS 91745(A), to "RG-10/U, approximately 15 feet." Type RG-10/U cable was specified because in the preferred installation the transmitters, receivers, and multicouplers are in the same radio space, and with the usual arrangement of cables, about 15 feet is required to make interconnections. The power loss in this length is about

3 watts at 400 mc.

However, the multicouplers are not always installed in the same space as the transmitters, but instead are at some distant point requiring up to 50 feet or more of transmission line between equipments. Type RG-10/U line has also been used for these long runs resulting in an 8 to 10 watt loss. In other cases, where the equipments are in the same radio space and close enough together to require only a few feet of cable, the 15 feet minimum length has been installed, although it had to be coiled up alongside the equipment.

Drawing RE 66H 2074 was distributed by Bureau of Ships letter S67/9-12(983) Ser 983-1179 of 18 Sept. 1953. This drawing modifies the specification for these RF

lines, requiring the use of RG-10/U only for lengths up to 15 feet and RG-18/U for lengths greater than 15 feet. This drawing also shows a minimum height of 6 inches above the deck for location of the bottom edge of the multicoupler. This takes into account the greater space needed, up to 12 inches, for bending RG-18/U where used.

In view of the policy to minimize RF power losses wherever possible, installation plans for these multicoupler systems are being revised to specify the use of RG-18/U in all cases in lieu of RG-10/U.

UHF AND VHF ANTENNA INSTALLATION

The following procedure should result in a more rigid installation of UHF and VHF antennas.

A template of 1/2 inch thick heat absorbing material should be used. This template is to be drilled to correspond with the bolt holes in the base plate of the UHF or VHF antenna. Four stud bolts will be inserted in these holes. The template with the bolts is set on a square steel plate and the stud bolts are welded to the plate. The template is removed. A stock of these plates, complete with the bolts welded in place, can be fabricated in the shop.

When a VHF or UHF antenna is to be installed, a plate with the stud bolts properly located, can be obtained from stock and welded to the supporting structure. By this method, the mounting plate is fabricated in a most accurate and economical manner.

SIGNAL GENERATORS OPERATING CAUTION

Several failures have resulted from the connection of a transmitter output to a signal generator output with subsequent accidental keying of the transmitter. This trouble results from the careless use of a signal generator for alignment of the receiver section of transceivers or receiver-transmitter combinations fed through antenna transfer relays.

The output attenuator circuits of most signal generators are made up of low power rating resistors. Transmitter power applied to these circuits is more than they can stand and will cause an immediate burn out of the attenuator. This means that the signal generator is useless for making sensitivity measurements until repairs can be made.

ANTENNA HINTS-PERSONNEL PROTECTION

The investigation of a fatal accident brought out the fact that the antenna leads to certain transmitters were not completely enclosed. In these cases, the bare antenna leads were not the cause of the accident, however, this deficiency is mentioned by the board, in their report, as a possible source of future trouble.

Prior to World War II, antenna trunks were extended to the top of transmitters. Radio spaces were located below the main decks for protection. The resulting long antenna trunk often absorbed most of the antenna current. In one measured installation, over 95% of the antenna current did not get to the antenna. To stop this loss, antenna trunks were eliminated in radio spaces. In new ships, these spaces were located near the topside, thereby shortening the length of the antenna feed lines. Accidents brought out

the fact that open antenna leads were not safe, especially when inexperienced personnel were working in the area. Consequently, Bureau of Ships plan RE 66D 2071 "Transmitting Antennas-Details of Antenna Trunk Continuation" was issued.

This drawing should be followed on all new installations requiring antenna trunks, and on all overhauls involving radio transmitting equipment.

The second factor mentioned by the investigating board, was that an antenna lead through a "Head and Shower" space was protected only by expanded metal. Such protection can be worse than none at all. Personnel, ignorant of the voltages which may be involved, will hang coat hangers and wash lines from any convenient spot, and the holes in expanded metal are ideal for this purpose. Remember that the type of lead is not always the governing factor since dangerous voltages can be developed on receiving antenna leadins when the ships own transmitters are operating.

The third factor mentioned by the investigating board, was an unsafe "dummy load." This "dummy load" consisted of three lamps in series. These lamps were connected to the antenna terminal and ground by a pair of insulated wires with clips attached to the ends of the wires. Such a tool can be dangerous in careless or inexperienced hands. The design of a practical "dummy load" which can be fabricated from locally available material, and can be safely used by any technician, is a much needed device.

Lastly, it should be remembered that the insulation on a wire carrying rf current can become the dielectric of a capacitor when handled by anyone whose body touches ground.

The following information should help in bringing about certain antenna installation practices topside.

(a) A warning sign is not a substitute for proper location of transmitting down leads and antenna trunks.

(b) Receiving antennas should be installed out of reach of personnel.

The energized portions of all antennas should be so located that it is impossible for a person to contact the antennas, except for the purpose of effecting antenna repairs.

Warning signs should be installed with the idea of reminding people that danger exists. At the same time, make every effort to isolate each antenna installation from accidental contact.

A receiving antenna circuit which is resonant at a particular frequency, may become dangerously energized when a local transmitter is operated at that frequency (or a harmonic of that frequency).

Remember that the shock which causes a man to stumble or fall, can be just as fatal as the shock which is the immediate cause of death.

ANTENNA HINTS

A set of antenna photographs received in the Bureau show an installation which probably will cause somebody a headache in the near future. The UHF antennas and the vertical wire receiving antennas appear to be normal, except that the vertical wire antennas are quite slack. The

real joker is a wire flat top transmitting antenna with a down lead that looks like the Gregg Shorthand symbol for "changes" or "charges." Perhaps these vertical wires are slack because movement in masts have caused wires to snap. If this is true, why didn't the installer include a safety link in the flat top? Sometimes we can justify not pulling wire antennas up tight, but we should remember that a down lead with a foot or more of slack can cause enough variation in the capacitance of the antenna to detune the transmitter.

TRAPEZOIDAL PATTERN MODULATION CHECKER/MONITOR

A suggestion for a trapezoidal pattern modulation checker/monitor has been submitted. The device has been found to be a safe, efficient, time saving way to check voice modulated radio transmitters. Listed below are some of its features:

1. Eliminates the danger of electric shock to electronics personnel checking voice modulated radio transmitters for percentage modulation using a trapezoidal pattern on an oscilloscope.
2. Reduces the time necessary to conduct such modulation tests.
3. Reduces or eliminates phase shift or distortion due to improper coupling between the oscilloscope and audio system.
4. May be used as a monitor to check the quality of transmission and for evidence of hum on the carrier.
5. May be used with equal effectiveness on suppressor grid, screen grid and plate modulated radio transmitters.

The usual technique to check the percentage modulation of a voice modulated AM radio transmitter using a trapezoidal pattern on a oscilloscope entails removing the protective side cover plates on the transmitter, connecting the hot side of the modulation transformer (in the case of a plate modulated transmitter) and running a lead to the horizontal plates of an oscilloscope through a blocking condenser and dropping resistor. R. F. voltage is picked up on a loop and fed to the vertical plates. The hazard in this case is going inside the equipment and connecting to a transformer that normally carries the maximum plate voltage of the transmitter. This device eliminates physical connection between the transmitter and testing equipment.

Circuit Operation:

Radio frequency energy is picked up by pick-up antenna A1 and is applied to choke RFC1 through antenna condenser C1. The far side of RFC1 is grounded. The voltage across RFC1 is applied to the Crystal rectifier, where demodulation or rectification takes place. The demodulated signal is then fed through choke RFC2, which is by-passed for radio frequency by capacitors C2 and C3 and is then applied to the horizontal plates of an oscilloscope.

The R. F. voltage to the vertical plates of the oscilloscope is applied through blocking capacitor C4, which is connected at the junction of C1, RFC1 and the Crystal.

The purpose of C4 is to keep the plate voltage of the oscilloscope from being shorted to ground via RFC1, as would be the case if a Navy Type OBL oscilloscope were used.

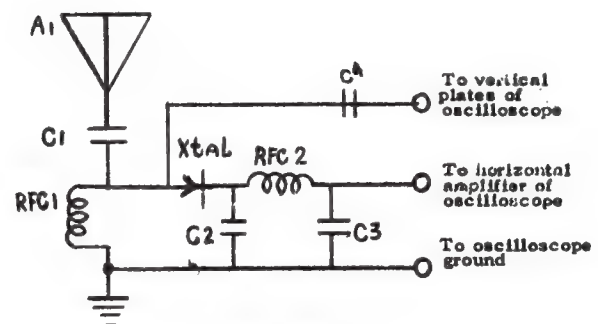
Operation:

Operation of the device is simple. After making connections to the oscilloscope, as shown in Figure 1, simply vary the distance between the pickup antenna and transmitting antenna until a vertical deflection of the desired size is obtained on the face of the oscilloscope. Speaking into the microphone will produce a trapezoid or wedge shaped pattern on the oscilloscope. By connecting ear-phones across the horizontal and ground terminals of the device, the quality of speech can be monitored and the presence of hum on the carrier can easily be detected.

Types TBM, TDE, TCS and TBW Navy Transmitters have been checked using this device. On frequencies higher than 15 MC, better results can be obtained by substituting UHF chokes like the Omite Z-50 (35 to 110 MC) or Z-144 (80 to 200 MC) for RFC1, although fair to poor results have been obtained on 142 MC using the BC-640, with a 2-1/2 mh choke for RFC1.

In favorably commenting on this suggestion, the Bureau points out that the device will not indicate overmodulation. It also should be borne in mind that a method of calculating modulation percentage is described in NavShips 91828(A).

Figures 2 and 3 show exterior and interior views of the device.



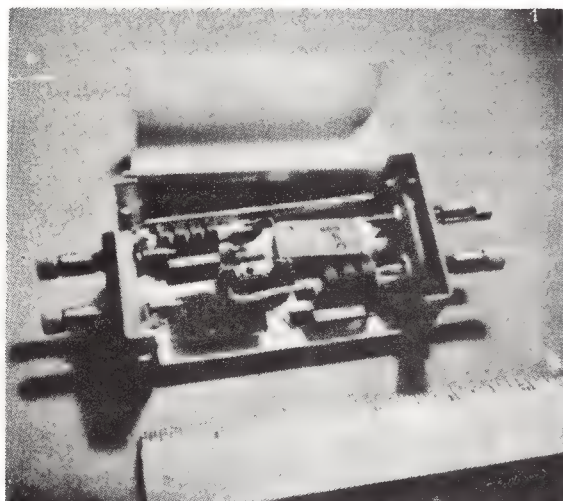
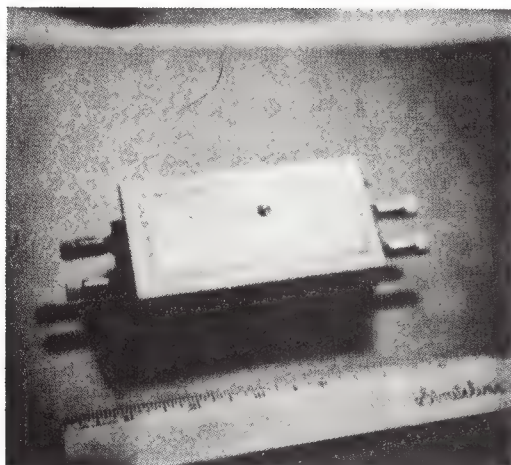
Parts List

- C1, C4 - .01 mfd 600V Capacitor
- C2 - 200 mmfd 600V Capacitor
- C3 - 250 mmfd 600V Capacitor
- A1 - Short vertical "pickup" antenna, 8 to 10 inches in length.
- RFC1, RFC2 - 2-1/2 mh choke
- Crystal - Type 1N21 or Raytheon CK705

Figure 1

RADIO TELETYPE

The tuning of receivers associated with radio teletype is far more critical than most people realize. Each of us has tuned a receiver, either communication or standard broadcast at some time, and found it to be a very simple process. We merely turned the tuning dial to the number



representing the frequency of the station that we desired to hear. We adjusted the dial for maximum sound and the volume control and the tone control (if any) to please our ear. It was very easy. After we determined the frequency, it was simply a matter of pleasing our ear. Unfortunately, the converter used with radio teletype is far more critical than our ear and extreme care must be taken in tuning the receiver to meet the converter's strict requirements if the equipment is expected to operate properly.

The requirements of the converter are few and simple, but very precise. They vary slightly, depending on the frequency to be copied. At frequencies above 500 kcs, a standard Navy teletype circuit would employ an 850 cycle deviation (shift), 425 cycles above and below the carrier frequency. At such frequencies, the converter must receive from the receiver audio output two audio tones, 850 cycles apart and centered about 2550 cycles. $2550 - 425 = 2125$ cycles and $2550 + 425 = 2975$ cycles. At frequencies below

500 kcs, the transmitting station would employ a 200 cycle deviation, 100 cycles above and below the carrier frequency. At these frequencies, the receiver must produce and deliver to the converter two audio tones 200 cycles apart and centered about 1000 cycles. $1000 - 100 = 900$ cycles and $1000 + 100 = 1100$ cycles. Under normal conditions, these requirements can be further simplified by ignoring the deviation (850 or 200 cycles as the case may be). Since the transmitting station sets the deviation and the operator of the receiver has no control with which to vary it, you need have no concern with deviation or the exact frequencies such as 900, 1100, 2125 and 2975 cycles, other than to realize that they do exist. If you tune the receiver to produce a shifting audio signal centered about 1000 or 2550 cycles, as the case may be, all other requirements will be met automatically and with reasonable accuracy. The converter is equipped with a tuning monitor to aid you in accomplishing these simplified requirements. It must be remembered that the tuning monitor is not a precision instrument and at its best, tells only a part of the tuning story. Of reliable communication is expected under adverse receiving conditions, all of the converter's requirements must be considered and more exact tuning procedures employed. In this article, the two methods found to be the most rewarding will be discussed.

METHOD ONE: Involves alignment and calibration of the receiver BFO (beat frequency oscillator). This is possibly the best method, since it need be done only once to insure permanently accurate and simplified tuning. This method applies only to receivers that have a frequency coverage above 500 kcs and only to the superheterodyne type such as RBB, RBC and RBS. Receivers of the TRF (tuned radio frequency) or regenerative types are covered later by method two. Before discussing realignment of the BFO, we should first review the standard receiver alignment procedure. A detailed description of this procedure can be found in the instruction book for the particular receiver with which you are concerned. Basically, it requires that you align the BFO to produce a 1000 cycle beat note when the vernier (front panel control) called "beat note" on some models, is set to zero. This is the only spot on the vernier that is calibrated. Somewhere in the approximate 3500 cycles covered by the vernier, is the 2550 cycles that we must supply to the converter. We must now fix this spot and mark it for future teletype use. Following the same procedure outlined in the instruction book, align for 1000 cycles at zero setting of the BFO vernier. An oscilloscope and audio oscillator should be used to accurately determine the 1000 cycles (See Figure 1).

Connect the receiver audio output to the oscilloscope vertical input and the audio oscillator to the horizontal input. Adjust the audio oscillator to 1000 cycles. Adjust the receiver BFO alignment screw (not the vernier) to produce a concentric pattern on the oscilloscope. Be sure that the BFO is 1000 cycles above the IF (intermediate frequency) in all aligned receivers. The receiver will operate normally for CW reception. The vernier may be adjusted to any frequency that pleases the operator. If the receiver is to be used with facsimile as well as teletype, you may locate the spot on the VFO vernier that does produce 2550

cycles and mark it for teletype use. Technicians and operators quite often take a casual attitude towards alignment of the BFO, so it might be wise to check the BFO to see if it is exactly 1000 cycles above the carrier frequency. METHOD TWO also involves the use of an oscilloscope and audio oscillator. The connections are the same as used in the alignment in method one, (See Figure 1), except in this method, the equipment must be mounted as a semi-permanent installation and used to constantly monitor the tuning. In this method, we are concerned with the exact frequencies 900, 1100, 2125 and 2975 cycles. The receiver should be tuned to the point that will produce a concentric pattern on the oscilloscope at both the mark and space frequency, when the oscillator is alternately switched from one to the other. This method is for use with regenerative and TRF type receivers and should not be used with other types until method one realignment has been accomplished. Now that you have the two methods, you must decide which is best suited to your particular teletype installation. This will depend on the type of receivers that you have. With a little effort, you can greatly reduce the number of ZFG's needed.

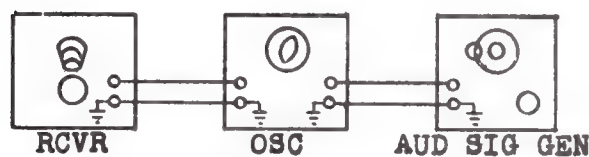


FIGURE 1

UHF Receiver Sensitivity Measurements

Many signal generators cannot be used in the conventional way for taking sensitivity measurements on UHF receivers because of the excessive amount of frequency modulation present in the signal when the signal generator is amplitude modulated. Since a number of substitutes for the approved signal generator AN/URM-26 is in use, a modified method of obtaining sensitivity originally worked out for the Model RDZ, RDZ-1 should be used with the substitutes. This method, which uses only CW from the signal generator, is described in Section 4 of NAVSHIPS 91331- "Service and Repair Manual for Radio Receiving Equipment Navy Model RDZ/RDZ-1." When using substitute signal generators for UHF sensitivity measurements, the procedures of this Repair and Service Manual should be followed.

How to Visualize a Phone Signal

Now that Naval Communications has entered a new era of communications techniques, Bureau of Ships intends to provide articles at intervals concerning Single Sideband, new equipment descriptions and information on antenna tuners and multicouplers.

The following article is intended to provide all interested personnel with the fundamental information on the technique of single sideband communications.

Having a clear picture of a 'Phone signal is the first requirement for understanding what single sideband is all about.

The following information is adapted from an article printed in QST, July 1950 Issue.

The usual description of amplitude-modulated telephony, with its "modulation envelopes" and "percentage of modulation," doesn't prepare you for further understanding. With a background of classical a.m. theory, it becomes practically impossible to form a mental picture of "suppressed carrier," "single sideband," and even plain c.w. In this article we hope to present a picture that will make it easy for you to understand "sideband" techniques.

We will start with the initial statement that to understand 'phone you must first understand c.w. Practically everyone knows that an unmodulated carrier and a c.w. signal with the key held down are the same thing. Anyway you tune them in on a receiver they act the same. On a panoramic receiver they look the same. Any test you can make of them at the receiving location will give the same result. They are the same. Furthermore, if they are stable they take up no room in the spectrum! You tune in one or the other on your receiver, with the b.f.o. on, and you can hear it over several dial divisions. Turn your b.f.o. off and the S-meter on, and signal gives a reading over a range of several kilocycles. But neither of these effects proves that the signal is broad—it only indicates that your receiver doesn't have infinite selectivity. By definition, 14,200.000 and 14,200.010 kc. aren't the same frequency, so they must be different. Actually, they differ by 10 cycles, and a receiver or other device that could separate signals 10 cycles apart could separate these two.

All this leads us to the first step in visualizing signals. Any single r.f. signal can be represented by an infinitely-thin vertical line on a plot of amplitude vs frequency. Fig. 1 is such a representation, except that the draftsman couldn't draw an infinitely-thin line that would show on the paper, and we had to settle for a finite-thickness line. The frequency can be read from the "Frequency" scale, and the amplitude from the "Amplitude" scale. The taller the line, the greater the amplitude. Don't worry about the units—the frequency scale could be megacycles, or even cycles at some part of the spectrum. Your panoramic receiver would show such a picture if it had infinite selectivity. If your receiver had infinite selectivity the S-meter would indicate the amplitude at one setting of the tuning knob as you tuned across the frequency range shown, and nothing at any other setting.

Two Signals

Suppose now that we wish to transmit some intelligence, and let's say that the intelligence is a simple 1000-cycle tone. One way to do it would be to set up another transmitter on a frequency exactly 1000 cycles removed from the first frequency. It could be higher or lower—it wouldn't matter so long as the separation was exactly 1000 cycles. A practical receiver (one that doesn't have infinite selectivity) would receive both signals simultaneously when turned to or near the correct frequency and the audio output of the receiver would be the 1000 cycle beat between the two signals. This is hardly a difficult thing to understand—you don't have to operate long in a 'phone

band before you meet up with "heterodyne QRM," which is exactly the same thing. Such a signal can be represented as in the drawing of Fig. 2.

In Fig. 2, the alternative signal that would also give a 1000-cycle beat is shown as a dotted line. However, we should still be transmitting our 1000-cycle intelligence if we used three transmitters separated as shown in Fig. 3. The signals removed 1000 cycles from the center frequency give 1000 cycle beats in the receiver and the audio output from the receiver is 1000 cycles, the intelligence we are transmitting.

"Ah, yes," you say. "But what about the 2000-cycle beat between the two outside frequencies? They're separated by 2000 cycles, and you will get a beat between them."

Right you are. Except for one special case, where the proper phase relations exist, this 2000-cycle beat would show up. But the spurious effect is minimized when the center signal is made large in proportion to the other signals. Thus if we didn't wish to introduce some extraneous or false intelligence at the receiver, we would have to hold the phase relations exactly right or keep the amplitude of the center signal.

Obviously, using three transmitters to transmit this 1000-cycle intelligence is doing things the hard way, and fortunately it isn't necessary. All we have to do at the transmitter, which we will assume is generating a single signal as in Fig. 1, is to beat (or "mix" or "modulate"—they're all the same) this signal with a 1000-cycle signal. As in any beating or mixing or modulating or heterodyning process, the output consists of the original two signals and two new ones, the sum and difference frequencies. The 1000-cycle audio signal isn't radiated but the others are. The resultant signal is exactly the same as the one we got in Fig. 3 using three separate transmitters! Being the same signal, it gives the same result in a receiver. And, fortunately for the art, the phase relations are right to eliminate the spurious 2000-cycle beat mentioned earlier. Sure, you know that when you mix signals like this you get such a signal—that's what your 'phone rig does—but you call it "modulation." But when you do the same thing in a receiver, you call it "heterodyning" or mixing or "beating." Let's use the word "modulate" from now on, remembering that the smaller-amplitude signal modulates the larger one, and that we run into new products if the signal we are modulating isn't large compared to the modulating signal.

At the start we said you had to understand c. w. to follow this discussion. Let's see why that is so. Suppose, for some strange reasons, that the sole purpose of radio communication was to transmit a 1000-cycle tone. Obviously we could do it in the manners just described, either by setting up three transmitters properly phased or by modulating the output from a single transmitter with 1000 cycles. Sooner or later some bright gentleman would come up with the idea that it isn't necessary to transmit the three signals of Fig. 3. Instead, you could transmit a single signal as in Fig. 1 and incorporate a to-be-modulated signal in the receiver. Duty-bound to receive only 1000-cycle intelligence, we could set up this to-be-modulated signal 1000 cycles higher or lower than the transmitted

signal. Every time the transmitter was turned on, we would get the 1000-cycle tone and in every respect we would have the same communicating ability that we had when the signal of Fig. 3 was working into a receiver where there was no to-be-modulated signal. That is exactly what we do in c. w. communications circuits, except that the receiving operator selects the tone and we complicate the matter by superimposing further intelligence in the form of a code made up of short and long signals and spaces.

The greater the amplitude of the incoming signal the more it modulates the local signal (beat oscillator) and the louder the audio output becomes. If we are to avoid beats between two or more different signals present in the receiver passband, the local signal (beat oscillator) must have a much greater amplitude than the incoming signals, just as in the 3-signal case described earlier.

Carriers and Sidebands

Now let's tie in these concepts to the sideband problem. The signal that all the other signals modulate has been—and still is—called the "carrier." As you can see now, it isn't a carrier at all, because it doesn't carry anything. In a c. w. receiver you call it the "beat oscillator," even though it does exactly the same thing as a transmitted carrier and might well be called a "local carrier."

The carrier by itself conveys no intelligence. The intelligence is contained in the smaller signals and is obtained from their modulating action on the carrier. These smaller signals are called "side frequencies," and a band of them is called a "sideband," reasonable names that have no confusing aliases or synonyms.

In a communications system based on the modulation of a large signal by a smaller one (a. m. or c. w.), the amplitude of the audio output from the receiver is proportional to the amplitude of the side frequencies. The frequency of the output is determined by the side frequencies. The carrier conveys no intelligence, so it doesn't have to be transmitted and might very well be supplied at the receiver.

Complex Modulation

It should be obvious that we don't have to confine ourselves to 1000-cycle tones. The modulating signal might very well be a complex signal, made up of different frequencies, without modifying the basic concept one iota. For example, if our purpose were to transmit simultaneously a 2500-cycle tone and a 1000-cycle tone of greater amplitude, we could set up five transmitters as shown in Fig. 4, with careful control of the relative phases so as not to have some 1500-, 2000-, 3500- and 5000-cycle signals in the receiver output. Or we could modulate the carrier with the 1000- and 2500-cycle signals and get exactly the same thing. The effect at the receiver would be the same. Speech and music are more complex than just two tones, but the principle is identical. The complete a. m. signal consists of the steady carrier and the two sidebands. The individual side frequencies in the sidebands are determined by the individual components that exist in the audio modulating signal at the instant under consideration. In an a. m. transmitter the audio frequencies modulate (you could say "are beat against" or "are mixed with") the carrier and

generate corresponding side frequencies through what you call "modulators" and "modulated amplifiers." You would be just as correct, if not more so, to call your modulator a "power amplifier" and your modulated amplifier a "mixer" (as you would in a receiver).

Tricks with Sideband

Since the carrier conveys no intelligence, it should be possible to dispense with it and introduce it at the receiver. This will save transmitter power and reduce heterodyne QRM. Unfortunately, if both sidebands are received at the detector where the carrier is introduced, the carrier has to have exactly the correct phase relationship with the sidebands if distortion is to be avoided. If only one sideband is present at the detector, there is no need for an exact phase relationship and there can be some frequency error without destroying intelligibility. The extra sideband can be removed either at the transmitter or at the receiver—one is single sideband transmission and the other is single sideband reception. Thus we could get rid of heterodyne QRM in our bands if no one transmitted the carrier but only one or two sidebands, but the double-sideband signals would require single sideband receivers at the receiving end.

When the carrier is eliminated at the transmitter and reinserted at the receiver, its frequency must be set rather carefully. For example, if it is set 100 cycles off, there will be an error of 100 cycles in all of the received audio signals. This is of no importance in radiotelegraphy, but in voice work manual receiver tuning for a single-sideband suppressed-carrier signal is somewhat critical. There are electronic means for simplifying this tuning, provided a weak carrier is transmitted to give a clue to the exact setting of the carrier.

If insufficient carrier is supplied at the transmitter, extra signals will be generated and radiated, as in the case of overmodulation splatter. If insufficient carrier is supplied at the receiver, extra signals will be heard, as in the case of trying to receive a single sideband signal with insufficient b.f.o. injection.

The minimum possible bandwidth of modulated signal is the bandwidth of one sideband. Ordinary a.m. signals use at least twice this bandwidth because both sidebands are transmitted. Claims that some methods of amplitude modulation result in narrower signals than others are obviously ridiculous—any normal system resulting in double sidebands will give the bandwidth of any other, provided, of course, that both systems are in proper adjustment. Out of adjustment, they can only result in still greater bandwidths.

Think of modulation, beats, heterodyning and mixing as exactly the same thing, and forget about carriers transporting audio and all of the other misconceptions, and you will be able to understand any new techniques thrown at you. Visualize the audio signal modulating the carrier to generate sidebands, and (at the receiver) the sidebands modulating the carrier to produce the audio signal, and it should all begin to make sense. For mental exercise, visualize what happens when you pull out the carrier during transmission and reinsert it at the receiver, or lop off one sideband at the transmitter or the receiver—it will all add

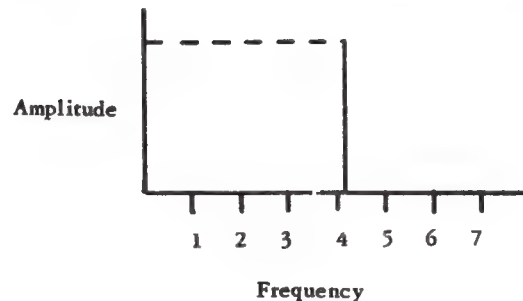


Fig. 1 — A representation of a single radio frequency, shown by plotting amplitude against frequency. A steady signal by itself takes up no room in the spectrum.

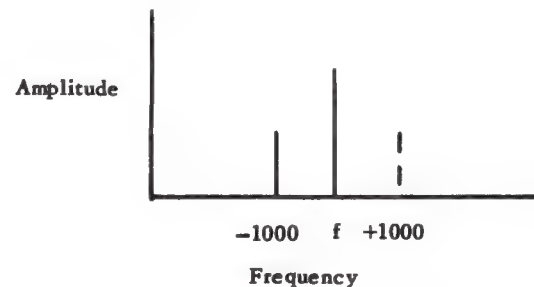


Fig. 2 — Two radio signals, separated by 1000 cycles will give a 1000-cycle audio signal when they are mixed in a detector or other non-linear circuit.

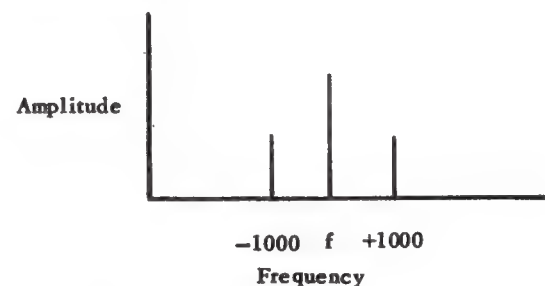


Fig. 3 — A representation of two weak radio signals and a stronger signal between them. This also represents the output of a radio transmitter modulated by a 1000-cycle tone.

up easily. Then try it again, thinking only in terms of "modulation envelopes" and "percentage of modulation."

SINGLE SIDEBAND EQUIPMENT INSTALLATION INFORMATION

The following is a current tabulation of applicable Bureau of Ships installation guidance plans and technical manuals for single sideband communications equipment and accessories:

Equipment	Outline Drawing	External Cabling Drawing	NavShips Technical Manual	Notes
AN/WRT-2 Transmitter	RE52F2129	RE52F2130 RE52F2131 RE52F2132	Not Assgnd.	
AN/URC-32 Transceiver	RE43B2010D	RE43F2012B RE43D2015B	Not Assgnd.	
SSB-1 Transceiver	RE43C2008A	RE43F2012A	92917	See BuShips Journal Jan 58
S-100 Transmitter-Receiver	RE43D2009A	RE43D2002A RE43F2012A	93127	
AN/URT-17 Transmitter	RE52C2098A	RE52F2007F	93161	
AN/WRA-1 TBL SSB Field Change Kit	RE43D2014A	RE52F2007F RE43F2012B	Not Assgnd.	
AN/URA-23 SSB Exciter	None	None	93162	Used with AN/URT-17
AN/URA-23A SSB Exciter	None	None	93163	
AN/SRA-20 Antenna Tuner	RE47C2012C	RE47D2011A RE47D20114A RE47D20115A	Not Assgnd.	Used with SSB-1 (See BuShips Journal Dec 1958)
AN/SRA-22 Antenna Tuner	RE47D2010A	RE47C2013A	Not Assgnd.	Used with AN/URC-32
AN/URA-24 Antenna Tuner	RE50D2032B	RE50D2033B	93164	Used with AN/URT-17
R-390()/URR Receiver	RE46D2108A	RE46D2036J	93053	
AN/WRR-2 Receiver	RE46D2110A	Not Available	Not Assgnd.	
CV-591()/URR SSB Receiver Converter	RE50D2031A	RE67F2104A RE50C2039A	93112	Used with R-390()/URR
CY-979/URR Cabinet	RE43D2007A	None	None	Used with R-390()/URR
CY-2416/U Cabinet	RE10D2219A	None	None	Used with R-390()/URR& CV-591()/URR
O-451/U Freq. Stand.	RE35D2002A	Not Available	Not Assgnd.	
O-471/U Freq. Stand.	RE35D2003A	Not Available	Not Assgnd.	

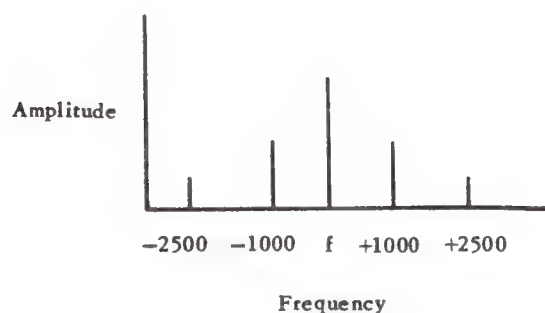


Fig. 4 — A representation of five radio signals or a single transmitter modulated by 1000- and 2500-cycle tones. The 1000-cycle tone has almost twice the amplitude of the 2500-cycle tone.

Installation guidance plans are normally forwarded to a standard installation activity distribution list as they become available. Additional copies may be obtained by request to BuShips, Code 693D. Requests for Technical Manuals should be made to the nearest Forms and Publications Distribution Point.

SINGLE SIDEBAND EQUIPMENT—GENERAL INFORMATION

SSB-1 Transceiver—The BuShips Journal of January 1958 contains a general information article on the SSB-1.

SSB-1 Field Changes—Field Change 3-SSB-1 for the addition of an AGC circuit is currently being distributed, and will be stocked at NSC Norfolk and NSC Oakland. Field Change 4-SSB-1 for the elimination of safety hazards is currently in printing. Notice of the availability of these field changes will be made in a future issue of the EIB.

AN/SRA-20 Antenna Tuner—This antenna tuner is supplied as Field Change 2-SSB-1 and is for surface ship installation only. The BuShips Journal of December 1958 contains a descriptive article on this equipment.

AN/URC-32 Transceiver—Installation plans distributed on this equipment are all marked "preliminary." This has been necessary since firm details are not available due to several minor equipment modifications, prior to production, to meet all the various installation requirements.

SSB General—Personnel interested in SSB theory should refer to the BuShips Journal of March 1958, and succeeding issues, for a comprehensive series of articles on this subject.

REMOVAL OF DEFECTIVE POWDER LINE SUPPRESSION FILTERS

As an emergency measure to permit the immediate reactivation of a teletype unit, it is recommended that defective power line suppression filters be removed. Repairs should be effected as soon as practicable thereafter.

DO YOU PLAY RUSSIAN ROULETT?

The following is based on an article which appeared in Technical Information Letter of May 1959, published by Scott AF Base:

Well, we have just had a tragedy within AACS (Airways and Air Communications Service) which again proves you can't be too careful. One of our Master Sergeant's was recently killed while working on a hot AN/FRT-15B. The records indicate the man was fully qualified, had observed all the safety precautions except one. In the process of checking out the Remote Dialing Line, he reached over and tugged at a wire saying, "I wonder if this could be it?" There was an arc, a yell and the Sergeant fell back against the wall. Although immediate aid was rendered by the men present and the medics, the man died almost immediately.

This was not a case where "familiarity breeds contempt," nor was it carelessness in the literal definition of the word. A lot of us who have worked around electronics equipment for years have taken voltages and currents of perhaps larger values. We aren't alive for any other reason except we were lucky. Therefore, we can't emphasize too much that the work we do is exceedingly dangerous, and the next mistake could very well be the last one.

Don't work on anything hot unless you have to. Don't stick your hands into hot equipment without using a shorting stick, etc. OBSERVE ALL PRECAUTIONS. READ Chapter 67, Electronics BuShips Manual, Section 5 on safety and BuShips Notice 9670 of 19 May 1959 regarding safety.

Admittedly each of us is only a cipher in this world, but this world isn't so bad after all so let's stick around as long as we can and enjoy it. NEXT TIME IT COULD BE YOU—OR ME.

SINGLE SIDEBAND PUBLICATIONS NOW AVAILABLE

The Bureau of Ships has recently stocked several single sideband information publications for use by interested communication personnel. These publications are available through normal publication supply channels.

NAVSHIPS 93224—"SINGLE SIDEBAND COMMUNICATIONS"

This is a reprint of a commercial publication that is of interest to communications personnel as a fundamental text book. The concept of SSB is explained in the basic principals.

NAVSHIPS 93271—"FUNDAMENTALS OF SINGLE SIDEBAND"

This publication is tailored for the needs of the electronics Technician and provides detailed design data. In addition, there is an excellent chapter on antenna and propagation theory. This publication had previously been supplied in chapter form in the "Bureau of Ships Journal."

SINGLE SIDEBAND TRAINING MANUALS

The Bureau continues to receive requests for a publication, "Report of Single Sideband Techniques and Design Requirements," published several years ago. This publication is no longer in print and is not available.

Publications on single sideband, available in the publications supply system, are:

NAVSHIPS 93271—Fundamentals of Single Sideband.

NAVSHIPS 93224—Philco Manual, SSB Communi-

cations.

Teletypewriter Distortion Test Unit

It has been proposed to use a "distortion service table for teletype." This provides the various power sources, outlets and space for the distortion test equipment in an easy-to-manage cabinet mounted on casters. Figures 1 and 2 are sketches of this unit showing views of the table and a schematic wiring diagram. The use of this distortion service unit is optional, and any ship or shore activity which can use this to advantage may construct one of these by following the sketches. Material required for this table should be obtained locally, preferably from scrap equipment, as was the original.

RACK MOUNTING FOR AUDIO-FREQUENCY AMPLIFIER AM-215/U AND AM-215A/U

A rack mounting has been designed for the Type Audio-Frequency Amplifier AM-215/U. Figure 1 illustrates the AM-215/U amplifier in the rack mounting. Construction data and fabrication information are also included in figure 1 for use by all Naval shore establishments.

This type of mounting with slight modification can also be used for the AM-215A/U amplifier. The front panel of the AM-215A/U amplifier will have to extend about $\frac{3}{4}$ inch in front of the mounting rack to allow the front panel to be lowered and the hinge pin to be removed.

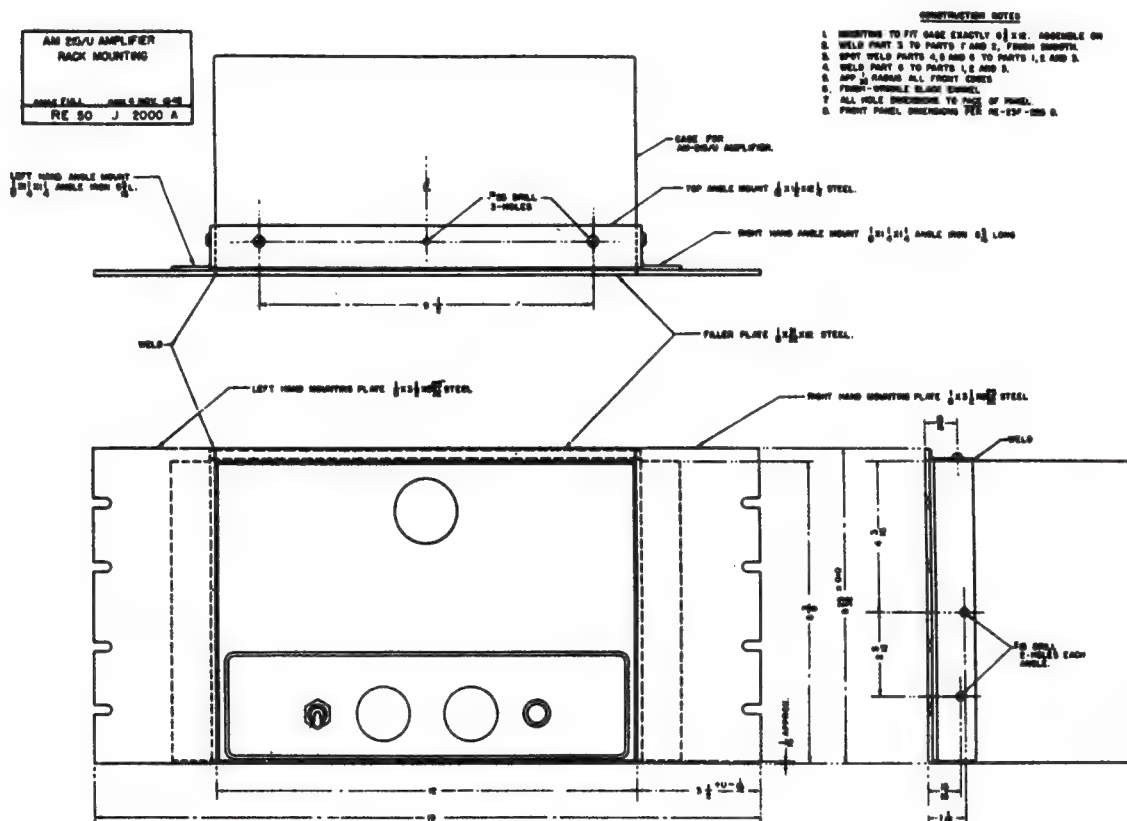


FIGURE 1. Rack mounting for AM-215/U and AM-215A/U amplifiers.

AM-215A/U A-F AMPLIFIER

Audio-Frequency Amplifier AM-215A/U is a 10-watt unit designed for communication work in conjunction with Naval electronic receiving equipment and associated loudspeakers, such as the type 49546 speaker. The amplifier should be installed in a protected location in such a manner that the power "on-off" switch, volume-control, and channel-selector are convenient to operating personnel. Mounting of the AM-215A/U amplifier may be accomplished by means of bolts through the top, back, or bottom of the case in the area shown cross-hatched in figure 2. Input,

output, and power circuits may be brought into the case by means of terminal tubes ("B," "C," and "E" sizes as applicable) in any of the cross-hatched areas providing, of course, for the method of mounting, clearance, etc.

The AM-215A/U amplifier is very similar to the AM-215/U amplifier previously procured. A type 12AU7 Voltage amplifier and phase-inverter tube is utilized in lieu of the 6J6 installed in the older model. The over-all dimensions of the AM-215A/U amplifier are 7" deep, 12" wide, and 8-3/8" high. The unit weighs 23½ pounds and a power source of 110 to 120 volts a. c., 50/60 c. p. s., approximately 55 watts, is required.

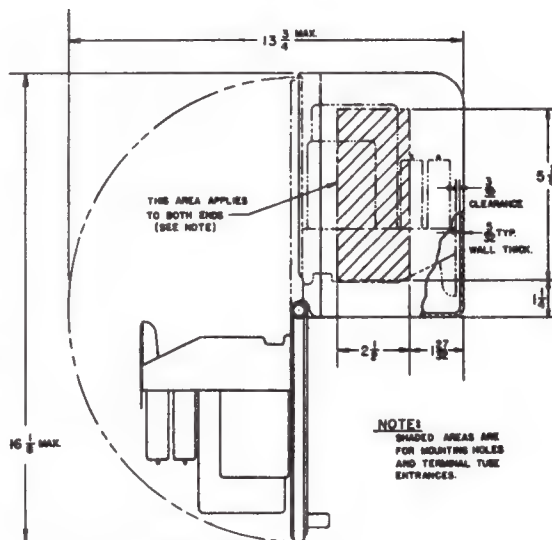
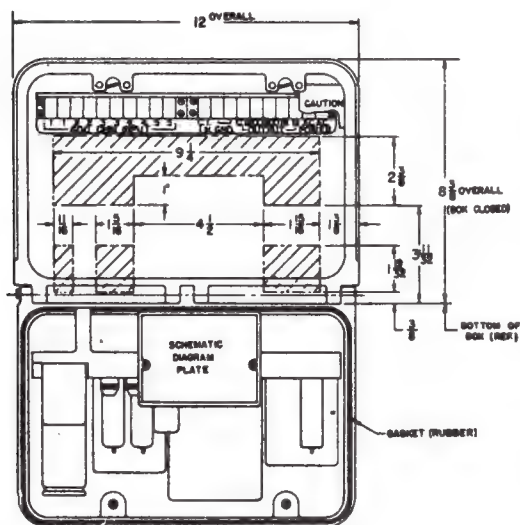
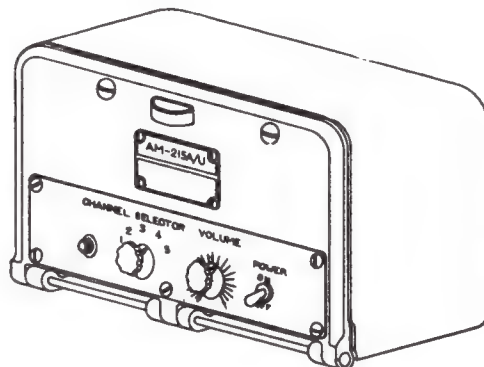
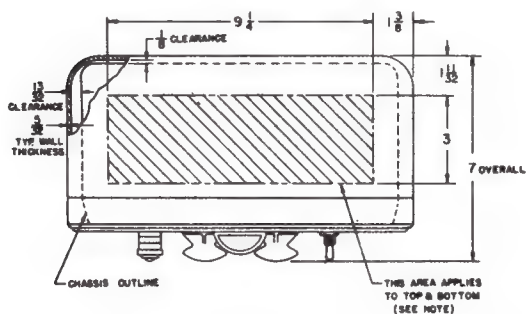


Figure 2. AM-215A/U overall dimensions.

Comparative AN/ARC-1 Meter Readings

Readings for the various metered stages in the transmitter and receiver of the AN/ARC-1 as obtained both by the TS-80/U and the TS-297/U are presented in Table I. These readings are not to be taken as a standard, but are to be used as a guide by which correct calibration of the AN/ARC-1 can be made, using the TS-297/U in place of the TS-80/U.

OUTPUT TRANSFORMERS FOR RADIO SETS AN/ARC-1 AND SCR SERIES

In order to utilize Navy type loudspeakers and amplifiers will AN/ARC-1 and certain SCR series radio equipments, it is recommended that the following transformers be installed adjacent to and connected with the respective equipments to provide proper impedance matching and balanced output to ground:

Equipment	Transformer	
	Manufacturer	Type
AN/ARC-1 and SCR-274	Halldorson	E1041
SCR-508, SCR-510, SCR-522, SCR-608, SCR-609, SCR-610 and SCR-624.	Stancor or Thordarson	A-4770 T61S25

IMPROVED CRYSTAL SOCKETS FOR AN/ARC-1 EQUIPMENTS

Failure reports indicate that the yellow moulded bakelite crystal sockets X-201 used in the AN/ARC-1 transmit-

ter-receiver are structurally weak and unsuitable for use aboard ship.

To solve the problem, late model sets have been equipped with new black high impact strength bakelite sockets.

DESIGN OF DUMMY ANTENNA FOR AN/ARC-1

If a dummy antenna is desired to aid in tuning the AN/ARC-1 it can be made by connecting three pilot bulbs in parallel. These bulbs can be fitted into a suitable container fitted with a plug which screws into the antenna connector. A 50-ohm load is presented when GE313, 0.17-amp., 28-volt bulbs are used.

ROTARY TEST RACK FOR AN/ARC-1 EQUIPMENT

The rotating rack for AN/ARC-1 servicing is shown in figures 1 and 2. This type of rack has seen wide use and is a great help whenever any sizeable number of equipments are being repaired. Many activities have manufactured these units but have varied slightly from the original design. The details shown in Figure 3 are those used by NAS Pearl Harbor except for a few slight changes which reduce the amount of machine work and simplify construction.

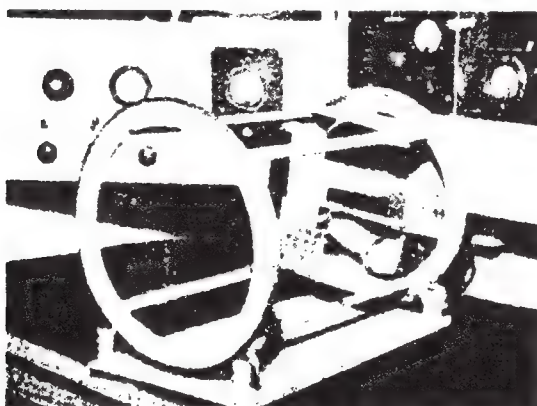


FIGURE 1.--AN/ARC-1 rotary test rack

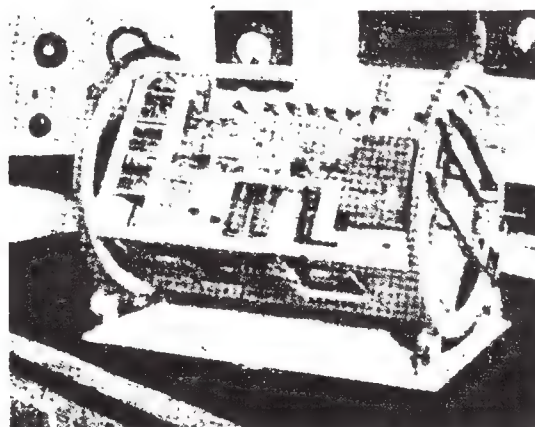


FIGURE 2.--An AN/ARC-1 mounted in the rotary test rack

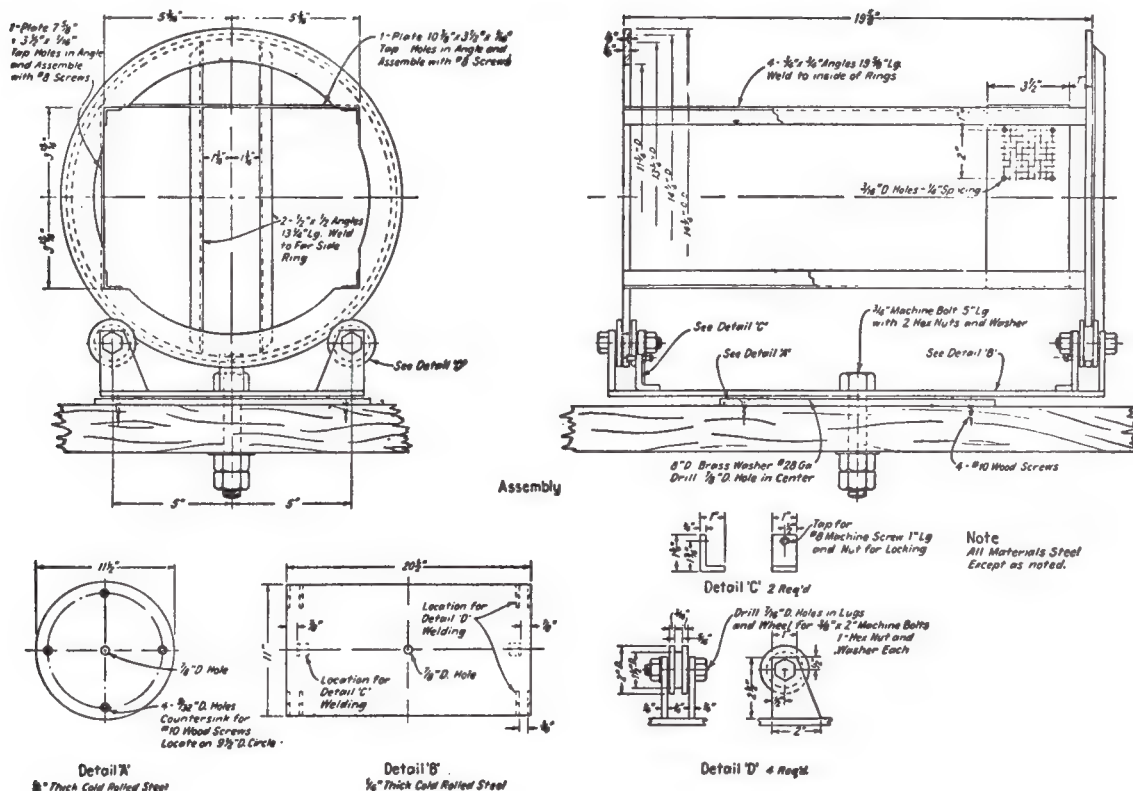


FIGURE 3.—Detail drawing for the rotary test rack

The only external connections required are the 28 volt d-c leads from the power source to the rack because a standard C-45/ARC-1 control box is mounted on the rack and wired directly to the 28 conductor plug (Cannon DP-D32-33) which plugs into the back of the set under test. The base plate is mounted on the bench so that the rack may be rotated through 360 degrees in a horizontal plane while the rings and rollers permit a 360 degree rotation in the vertical plane. These features allow a set to be easily turned in any position for servicing without any interruption in power.

This method may also be made applicable to other types of shipboard electronic equipment.

AID TO AUTOTUNE ADJUSTMENT OF AN/ARC-1

A damaged Excelite nut-driver or screwdriver with slight alteration can be put to good use in maintaining the autotune units of the AN/ARC-1 radio equipments. Figure 1 illustrates how such a damaged article can be utilized together with the autotune adjusting wrench provided with the AN/ARC-1 equipment, to make a useful tool.

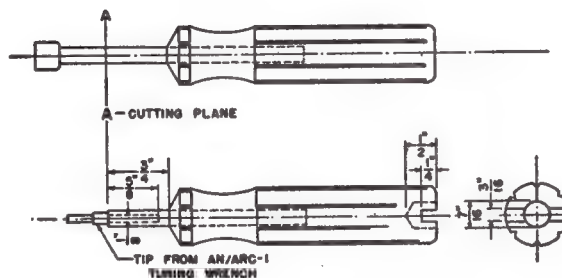


FIGURE 1.—Combination tuning and locking wrench

After sawing off the shank at A-A, a 1/8-inch hole is drilled in the end of the shank to a depth of 5/8 of an inch. The tip of the AN/ARC-1 tuning wrench (with the knob removed) is then pressed into the shaft for a press fit. Finally, a 7/16-inch hole is drilled in the handle to a depth of 1/2 inch and a slot cut across the end 3/16 of an inch wide and 1/4 inch deep.

LOCKING WRENCH FOR AN/ARC-1

During the alignment and tune-up of the AN/ARC-1 transmitter it is sometimes necessary to lock and unlock the auto tune heads several times.

To facilitate this operation and insure the proper tightening of the heads, a technician at NAESU has designed the locking tool shown in figure 2.

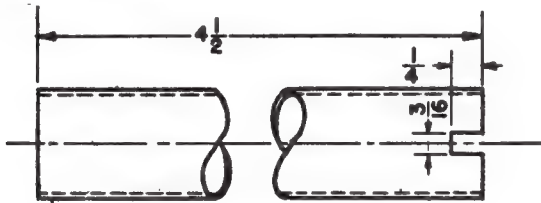


FIGURE 1. --AN/ARC-1 locking wrench

It may be constructed in a few minutes out of a piece of seven-eighths inch O. D. brass or fiber tubing.

PLUG AND RECEPTACLE FOR USE IN SERVICING AN/ARC-1 EQUIPMENTS

In cases where it is necessary to remove an AN/ARC-1 equipment from its mounting base for servicing, facilities for connection to the power source and control unit are not usually available. The Bureau has, therefore, procured a quantity of plugs and receptacles, identical to the termination plug of the transmitter-receiver (symbol P-101, Cannon DP-D32-34) and the receptacle in the mounting base (symbol J-104, Cannon DP-D32-33) so that a connecting cable with the plug on one end and the receptacle on the other end may be made up. When the transmitter-receiver is removed from the mounting rack the receptacle end of the cable may be plugged into the plug of the transmitter-receiver and the plug end may be plugged into the receptacle of the mounting base. In making up the connecting cable, it is suggested that individual wiring be used and placed in a flexible conduit, or laced, as it would then be more flexible than solid cable. The length of the connecting cable would depend upon the distance from the mounting base to the transmitter-receiver after it has been removed for servicing. It is suggested that the connecting cable be made about 6 feet long.

SUGGESTIONS FOR ISOLATING TROUBLE IN AN/ARC-1 EQUIPMENTS

When routine tests have failed, the following suggestions may aid in isolating the trouble:

(1) If the set fails to track properly after alignment, check REC and TRANS selector heads to see that they are both set for the frequency giving greatest MIX Ig; then check harmonic amplifier, or transmitter output, with wave meter or Signal Corps type I-106 field strength meter to ascertain that they are delivering the eighteenth harmonic.

If the frequency is found to correspond to the seventeenth or nineteenth harmonic, the oscillator, harmonic generator and harmonic amplifiers should be realigned and the alignment of the transmitter should be checked.

(2) If the MIX Ig current is low, check the voltage on the grid of V-107 using an electronic voltmeter with a 100,000 ohm resistor in series with one lead. If the reading is less than 20 volts, the trouble may be due to tracking choke L-131 in the 2F oscillator. There may be no apparent damage to the coil beyond scratched enamel, etc., and it may check OK but still function improperly. Try replacing the coil. Condenser C-143 may also be faulty and replacement should be tried.

(3) If harmonic generator output is weak or dead, check the coupling condenser in the affected stage. C-146, C-154, C-161 and C-166 are the chief offenders.

(4) After removing shorted 6AK5's or replacing bypass condensers, be certain to inspect or replace the 1/2-watt resistors in the screen and plate circuits. They usually have become overloaded and have changed in value. This is also true of the guard channel.

(5) If tubes V-108 or V-109 go flat or burn out, check the 500-mmfd. condensers C-331 and C-328. A defective condenser raises the filament voltage. (This is possible in any of the filament circuits.)

(6) The field strength indicator Signal Corps type I-106 can serve as a very efficient combination signal chaser and aligning device for the harmonic generator provided the indicator is supplied with a good crystal. One activity has built a separate power unit and tuning head jig. The harmonic generator can be removed from the set, repaired, calibrated, and tuned up on the bench and replaced in the set in much less time than would otherwise be required.

(7) If transmitter fails to align on or below channel four, check r-f plate chokes for open windings.

(8) If the driver tube fails to respond, check cathode resistors R-115 and R-116. Damaged resistors may increase to about twice their original value. If they are high in value, the tube has probably experienced very high cathode current which is likely to recur. Replace the resistors and the tube.

(9) If the driver or power-amplifier grid-current is low, check the 10-mmfd. coupling condensers C-116, C-117, C-124, and C-125; watch for the one that heats up and "sweats." Check the voltage from pins 6 and 2 on the 832A tube to ground. If there is a large difference between the two voltages, replace the condenser on the side that reads lowest.

(10) If transmitter checks OK except for erratic or zero output, the fault may be in the antenna relay K-101. Erratic output may be due to poor adjustment. If output is zero, rotate antenna selector head slowly noting peak PA IK values which will all be substantially alike if the relay fails to close on the transmitter side. Check for open coil, frozen bearing, misadjustment, or loose contact. Also check for light roller contact on T-105 and open or short circuit in transmission lines and plugs.

(11) If receiver loses sensitivity at times up to 75 to 100 microvolts (after the usual adjustment), again check

antenna relay contact points on receive position, etc. If relay checks OK, test the voltage from ground to the junction between R-274 and R-278 and SENS control in maximum position. This should be between 2.1 and 2.7 volts. If it is outside these limits, check the values of R-273 and R-278 which should be 10,000 ohms plus or minus 5 percent and 430,000 ohms plus or minus 5 percent, respectively.

(12) If the autotune cycles in one direction only and fails to reverse, it is an indication of continuous ground on the reversing relay coil. This may be due to one of the following causes:

(a) There may be accidental grounding of one of the control leads either in the set, in the control unit or in the external wiring.

(b) The pin terminating the tension springs on the motor control clutch band may have slipped exposing a knurled portion of the pin. This may prevent actuation of the limit switch, S-103B, thereby holding the relay operated.

(c) On early sets there was close clearance between the ground side of the K-102 relay coil and apparatus on the front jack panel. Contact at this point may be the cause of failure.

(13) If the autotune is erratic in operation on certain channels only, check the corresponding slots in the cam drum for burrs, improper fit, etc. Also check for freedom of movement of the pawl spring in the slot at the end of the pawl.

(14) If the autotune motor continues to operate, it may be that the main drive sprocket has become loose requiring a tightening of the set screws.

(15) If mixer tubes are short-lived or continually go flat, check for high filament voltage. Condenser C-330 has been an offender.

AN/ARC-1 TEST HINT

The Signal Corps type I-106-A indicator, part of the Signal Corps type IE-35-A supplied for servicing AN/ARC-5 VHF components, can be used rather successfully for tracing signals in the harmonic generator and harmonic amplifier sections of the AN/ARC-1 main channel.

When, as has occasionally happened, some fault exists in this section resulting in no output into the receiver or transmitter mixers it is desirable to know in which stage the trouble lies. Operation of the oscillator can be checked by reading grid drive on the harmonic generator but no such

check can be made of the other stages due to the two amplifiers V-108 and V-109 operating class A.

Looping a short length of wire around the I-106-A antenna and looping the other end into the plate circuit of the stage being tested will result in an indication of RF on the meter when the latter is tuned to frequency. The indication taken from the harmonic generator (V-107) plate may be quite small but that on each of the amplifier plates will be easily detected if those stages are operating.

RESONANCE INDICATOR FOR AN/ARC-1 RECEIVER TUNING

It is customary in receiver tune-up procedures to utilize an a-c output meter as an indication of resonance when tuning the various i-f and r-f circuits. Whereas, an a-c meter is perfectly acceptable as a resonance indicator in the AN/ARC-1 receiver tune-up process, there is available in this set a d-c voltage which is steadier and, therefore, easier to use for peaking the tuned circuits. This voltage is found between the cathode (pin 7) of the AVC detector-amplifier tube, V-129, and ground; and the same voltage appears at pin 7 of plug P-101 at the rear of the transceiver unit.

When no signal is applied to the circuit, the potential at these points is in the magnitude of plus 50 volts with respect to ground. As a signal is applied, this voltage becomes less positive and, in the presence of a strong signal, will be driven negative. Hence, if a vacuum tube voltmeter or high-resistance d-c voltmeter (20,000 ohms-per-volt) is connected between pin 7 of P-101 and ground, the i-f circuits and r-f circuits of the receiver may be peaked by tuning for a **minimum** reading on the meter. In order to avoid overloading, the level of the signal into the i-f or antenna circuits should be kept sufficiently low so that the observed voltage does not go negative.

AN/ARC-1 CAPACITOR FAILURE

Investigation of several failures of capacitor C-179 in AN/ARC-1 equipments has led to the conclusion that the mounting arrangement should be changed as shown in Figures 1 and 2 and a capacitor with higher voltage rating substituted.

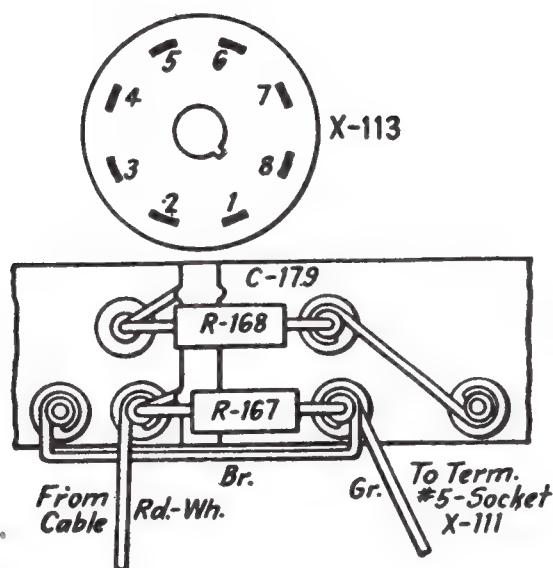


FIGURE 1.—Original arrangement

Electrical test on a quantity of these capacitors taken from the production line at Western Electric has shown that they are not adequate for this circuit application. In addition, the capacitor is mounted in the set as shown in figure 1 and may possibly have become misplaced to such an extent that the end nearest to tube socket X-113 was actually in contact with the terminals projecting from the socket. In this case the bakelite insulation on the condenser would soon wear through and result in a contact between the grounded end of C-179 and socket terminal No. 2 (heater terminal 18 volts) or No. 3 (plate terminal). It is believed, therefore, that the difficulty might be due either to random defective condensers or misplacement in the assembly or both.

Equipments commencing with Western Electric serial No. 5700 and Westinghouse serial No. 11663 will be modified to avoid trouble due to misplacement of this capacitor by rearranging the terminal board on which it is mounted, as shown by Figure 2, and by substituting a 200-mmfd. 500-volt capacitor.

Perhaps a warning to service men that C-179 should have at least 1/8" clearance from the terminal of socket X-113 is all that is warranted although the change is one that could be readily made at any repair shop. This change will also be shown on the wiring diagram, Figure 43, of the maintenance handbook when it is reissued.

AN/ARC-1 MISTRACKING

Recent experience with the AN/ARC-1 equipment has indicated that mistracking of the transmitter can occur, if, during the alignment process, the antenna circuit is not properly detuned. This difficulty is evident when the PA IG test meter current is reduced to less than 0.3 ma. with

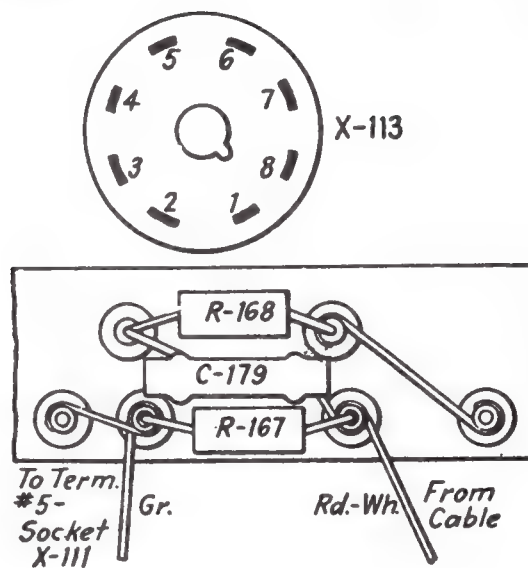


FIGURE 2.—Revised arrangement

the antenna detuned and the transmitter tuned for minimum PA IK meter current, as called for in Section 2, Paragraphs 2b, 4, f and 2b, 4, g of the maintenance and operating handbook. It is believed that some equipments have been delivered to the field in this condition.

In realigning such equipments in the field, the antenna circuit should be detuned to a point giving a minimum of current in the phantom antenna, as called for in Section 5, Paragraph 15, c, (8) of the maintenance handbook. The exact setting of the antenna dial can be found by observing both the antenna and the PA IK test meter currents, noting that between peaks of output there are regions in which the output is a minimum and in which the test meter current remains constant. The dial should be set in the center of one of these regions as an alternate for detuning the antenna circuit. This circuit may be disabled by short circuiting antenna roller coil T-105B. For this purpose a piece of thin flat spring stock bent into a U, with one side curved to ride on the slip ring on the lefthand end of the coil while the other side rests against ground, will be found useful. If, after realignment, it is found that transmitter dial settings for maximum PA IG and minimum PA IK are not in close agreement on all channels, it will be necessary to repeat the alignment with a new initial set of trimmer inductances L-112 and L-114. When the dial settings agree closely on all channels except one or more in the group 1 to 4, the separation between turns in L-112 and L-114 should be increased to about 3/16". If satisfactory performance is obtained on all lower number channels such should be decreased to about 1/2 its former value.

PARASITICS IN THE AN/ARC-1 EQUIPMENTS

If the output of an early model AN/ARC-1, when properly tuned, drops off when positioning the meter switch to

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

read "Driver Ig" with the meter in the circuit, and if no circuit deficiencies are observed, the chances are that the parasitic oscillations are present. The final check for determining if a parasitic oscillation does exist is to remove the crystal and tune the final amplifier for any indication of plate current. If any parasitics are found, it is recommended that a 100-mmfd. condenser be placed across R-114. On equipments built by Western Electric starting with serial number 1000 and Westinghouse serial number 8750 these condensers are already installed and are designated C-134.

ELIMINATION OF R-F "HASH" PRODUCED BY AN/ARC-1 DYNAMOTOR IN ASSOCIATED EQUIPMENTS

Tests have indicated that radio-frequency noise emanating from the dynamotor of AN/ARC-1 equipment may produce interference in associated equipment. The dynamotor noise is apparently radiated (rather than conducted) by the power input leads where no shielded cable is used, because the interference disappears when the antenna is disconnected from the receiver.

The Naval Research Laboratory has been able to reduce this interference to a negligible level by the insertion of a 4-mfd., 50-volt condenser in the back of rack, MT-100/ARC-1, connected between terminal 1 of J-403 and ground.

DEFECTIVE AUTOTUNE LOCKING BARS IN AN/ARC-1 EQUIPMENTS

During the assembly of AN/ARC-1 transmitter-receivers, defective locking bars for the frequency selector heads were inadvertently included in 30 of the finished units.

The defect will not become evident until numerous frequency-changing operations have occurred. Then locking the selector at the desired setting will become impossible because certain of the locking bars are too short.

The AN/ARC-1 units in which the difficulty will probably occur are in the serial number ranges from 1479 to 2278 and from 8360 to 9671. If it does occur, ascertain the serial number of the autotune mechanism. To do so, remove the set from its case, turn it over and look directly to the left of the drive motor for a red metal nameplate riveted to the frequency selector casting. On the nameplate are stamped the type and serial numbers and the legend, "Manufactured by the Collins Radio Company".

The following autotune assemblies contain one or more locking bars that are not long enough:

A11870	A12632	A13475
A11887	A12783	A13626
A12035	A12879	A13710
A12062	A12934	A13713
A12093	A13037	A13734
A12242	A13038	A13770
A12279	A13236	A13857
A12293	A13333	A13903
A12293	A13333	A13903

A12442
A12560

A13370
A13421

A14021
A14104

BURNING OUT OF MODEL AN/ARC-1 TUNING MOTORS *

One of the most persistent causes of burning out of the tuning motor in model AN/ARC-1 equipments has been the shorting of the leads to the motor-reversing relay K-102 against adjacent metal parts. This supplies a ground return causing the motor to run continuously and eventually burn out.

Western Electric (CW) sets with serial numbers above 5000 and Westinghouse (CAY) sets with serial numbers above 11,000 have been inspected for proper dressing and length of these leads before shipment. However, sets in the field with lower serial numbers should be inspected by field maintenance activities as soon as possible to prevent needless failures of the tuning motors.

While proper dressing may prevent trouble for a limited length of time, there is a tendency for the leads to drift back to the dangerous position if they are left long enough to do so. The real solution to the problem is shortening the leads so that they are not long enough to ground to the chassis or nearby metal parts.

* Digest of Airborne Radio & Radar News.

FORCE-DRAFT VENTILATION FOR AN/ARC-1

The type aircraft generator that is made up of both an a-c generator and a d-c generator may be made to supply its own ventilation. To accomplish this, remove the forward end bell and take out the armature. Remove all mounting screws for the field windings and pry them loose from the case. Mounted on the armature is a laminated core for the a-c generator section. The core is made up of laminated poles whose blade-like surfaces are diagonal with respect to the axis of rotation of the armature and, when driven at high speed, with drive air through the casing. Using this forced ventilation, the motor-generator has been run continuously for 30 days without any trouble.

LUBRICATION DATA FOR AIRCRAFT RADIO EQUIPMENT AN/ARC-1 AND AN/ARC-1A

The Government Specification lubricants to be used and their stock numbers are given in Table 1 below for corresponding lubricants as given in the Aircraft Radio Equipment AN/ARC-1 Maintenance Handbook. These lubricants should also be used with Radio Set AN/ARC-1A. The corresponding lubricants as listed in AN 16-30 ARC-1-7 are:

For. No.	Use
AN-O-4	AN-O-6a
AN-G-3a	AN-G-25
AN-O-6	AN-O-6a
14L3 Hard	14-L-3

Table 1

Handbook of maintenance instructions for AN/ARC-1, Use
AN 08-30 ARC1-3, Section V, Page 5-8, Paragraph 8a.

Type designation	Govern- ment speci- fication	Supplier	Name	Government specification	Stock No.	For
A		Cities Service Co.	HO-38G Oil	AN Aero Spec AN-O-6a	Aviation Supply Office. Stock Cat. No. R14-O-2405.	1 qt. can.
B		Cities Service Co.	North Star 000 Oil.	AN Aero Spec AN-O-6a	See above	
C	AN-6-3a	Socony Vacuum	Mobilgrease PD-535-A.	AN Aero Spec	Aviation Supply Office. Stock Cat. No. R14-G-982-20.	1 lb. can.
		Colonial Beacon	M-285 Grease	AN-G-25	See above	
D		Fiske Brothers Co.	Lubriplate 105	AN Aero Spec AN-O-6a	See above	
E	AN-O-4	Esso	Aviation Instrument Oil per WS-429.	AN Aero Spec AN-O-6a	See above	
F	14L3	Standard Oil Co. of N.J.	Andok C	Navy Spec 14-L-3	Fed. Standard Stock Nos: 14-L-84-900- 1 lb. can. 14-L-84-910- 5 lb. can.	
G	AN-O-6	Pioneer Instru- ment Co	Pioneer Instrument Oil No. 1	AN Aero Spec AN-O-6a	See Above	

AN/ARC-1 LUBRICATION PREVENTIVE MAINTENANCE

The following article is reprinted from the **Airborne Digest** of August 1947. Inasmuch as proper lubrication is of prime importance in the maintenance of electronic equipment, the information contained herein should be of interest to all concerned.

"Recent field reports indicate that the channel-selector drive motors on the AN/ARC-1 equipments are beginning to fail as a result of mechanical overload caused by lack of lubrication in the autotune assembly.

"The loss, through aging and use, of lubrication in the worm drive of the autotune has been the point most frequently mentioned as a source of increased friction and drag on the motor. With the aging of AN/ARC-1 equipments in service, this type of failure can be expected to increase unless immediate steps are taken by all activities servicing AN/ARC-1 equipments to check, and lubricate where necessary, all moving parts in these equipments at regular intervals.

"The Handbook of Maintenance Instructions for the AN/ARC-1 carries detailed lubrication instructions on page 5-8 in Section 5. Since operating time logs or autotune cycling logs are not kept on these equipments, it is difficult to comply with the time intervals specified for lubrication, but this does not make the remaining instructions on lubrication impractical. The decision on when to lubricate can be made after a visual inspection of bearings and

moving parts when the equipment is being serviced in the shop.

"It must be borne in mind that excessive lubrication can be as bad as no lubrication at all. Lubricant in the wrong places can act as an excellent collector of dirt and dust and help jam parts that were designed to operate without lubricant. All moving parts that are normally lubricated should be inspected at regular intervals and, if there is sufficient oil or grease which has not become hard, caked, or dirty, and the parts are free-running, then lubrication may be omitted until the next inspection. If lubrication is required, clean off the old lubricant and dirt and apply the minimum amount of fresh lubricant to the working surfaces.

"The oil or grease must be kept from adjacent parts which are not intended to be lubricated; for example, when adding grease to the dynamotor bearings, it must be kept off the commutators. Accidental oiling of the autotune clutch would be especially harmful and would probably make the replacement of the clutch necessary."

LOADING AN/ARC-1 TRANSMITTERS

An ACG field report suggested the following method of loading the AN/ARC-1 transmitter where input voltages are low:

The directions in the instruction book (sec. II, par. 2b, 1, i) state that the transmitter should be loaded up to

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

the highest peak of "PA Ik" within the limits of 0.7 to 0.8 ma. That is correct if the input is 28 volts. However, with auxiliary power units sometimes encountered in the field the input voltage is considerably less and with low voltage the proper load point is at a somewhat lower meter reading. With 28 volts input the "MOD Ik" is 0.75 ma. on the meter. Therefore, no matter what the input voltage is (22-30 volts), adjusting the ANT knob for the peak of "PA Ik" nearest the "MOD Ik" reading, whatever it is at that voltage, will load the transmitter satisfactorily.

AN/ARC-1 CIRCUIT CHANGES

The Bureau has approved the following modifications to be incorporated in the production of transmitter RT-18/ARC-1:

(1) Addition of a 120-ohm resistor R-110 in parallel with the mixer roller coil coupling link, to prevent excessive transmitter excitation and to minimize the variation in excitation resulting from changes in frequency.

(2) Reduction of R-114 from 1500 ohms to 430 ohms, to reduce the driver grid current meter reading approximately 13 percent and prevent off-scale readings.

These resistors may be obtained from spare parts, or will be supplied upon request through the normal supply channels.

I-F AMPLIFIER CHANGE IN AN/ARC-1 VHF RECEIVING EQUIPMENT

The performance of certain models of the AN/ARC-1 VHF radio receiving equipment has been adversely affected by instability in the i-f amplifier as far as regeneration and bandwidth are concerned. Some activities have attempted to overcome this difficulty by detuning one or more i-f

stages. This expedient stabilizes the amplifier but results in undesirable broadening of the response band of the receiver.

To solve the problem, the manufacturers have incorporated a parallel R-C filter in series with the control grid leads of the second and third i-f amplifier tubes in all models subsequent to serial numbers CW 26550 and CAY 16580. The filter acts as a voltage divider to reduce the gain to the point where the amplifier may be lined up "on the nose" and the band pass characteristics preserved.

Activities serving equipment containing these filters are cautioned not to remove them. The i-f alignment of these sets is normal and is covered in the AN/ARC-1 Maintenance Handbook, AN-08-30ARC1-3 dated 26 April 1944. A revised maintenance handbook shows the addition of the filters.

Models of the AN/ARC-1 equipment which have not been so modified and which exhibit instability or regeneration in the i-f amplifier may be modified by service activities having the necessary facilities. The materials required for modifying each AN/ARC-1 equipment are two 330,000-ohm 1/4- or 1/2-watt resistors and two condensers (midget mica), each having a capacity of from 16 to 18 mmfd. The modification procedure follows:

(1) A parallel R-C filter is made from one condenser and one resistor. One filter is inserted in series with the control grid lead to V-117 (the second i-f amplifier tube), and the other filter is inserted in series with the control grid lead to V-118 (the third i-f amplifier tube). The filters are wired into the circuit as near the tube sockets as practical. Care must be taken to make good connections and all excess solder or flux must be removed. The amplifier should then be realigned following the procedure given on page 5-20 of the AN/ARC-1 Maintenance Handbook, An-08-30ARC1-3.

AN/ARC-1 TROUBLE SHOOTING NOTES

Difficulty Encountered

AN/ARC-1.--Transmitter and receiver readings low.

Transmitter and receiver intermittently becoming inoperative a short time after switching to a new channel.

AN/ARC-1.--The channel selector drive motor, B-101, ran continuously for about five hours. This motor is not designed for such continuous operation and heated excessively, causing the insulation of the armature and field windings to melt.

AN/ARC-1.--On checking it was found that the filament voltage of V-107 had increased to 13.5 volts and the filament voltage of V-106 was zero.

Cause and Remedy

Replaced V-102, 103, 114, 124, (all 6AK5's). Old tubes found to be very low. U.S.S. *Lind* (DD-703)

The panel spring on the home stop panel came off. The tip of the panel came up and caught the clutch band, causing the limit relay to stay in one position, thus providing a complete electrical circuit for the motor so that it ran continuously. The panel spring is hooked to one of the screws holding the limit relay in place.

The motor was replaced and a drop of solder was put over the screw end to keep the spring in place.

Capacitor C-327 in the receiver section was shorted. Replaced and resumed normal operation.

REPAIR OF ROLLER-COIL TIE RODS IN MODEL AN/ARC-1 RADIO EQUIPMENT

It is no longer necessary to remove and disassemble the entire roller-coil assembly in model AN/ARC-1 radio

equipment in order to replace a broken roller-coil tie rod. The following method of repair may be accomplished with the roller-coil in place:

1. Note the position of the roller-coil trolley wheels so they may be reset if accidentally displaced.

2. Remove the nuts securing the broken tie rod, saving the flat washers and lock washers for re-use. If necessary, snip out a section of the broken rod with diagonal cutters, and remove all parts of the broken rod.

3. Cut a 2-inch length of 1/4-inch diameter, laminated-phenolic rod. Finish the ends flat and square. Drill each end axially to a depth of 1/2-inch and tap with 4-40 N.F. -3 thread.

4. Place the new rod in position between the phenolic end plates of the roller-coil assembly and secure with machine screws using the original washers. Note: Before tightening the screws, make sure that the new rod places no strain on the end plates.

5. Check the position of the roller-coil trolley wheels. If necessary, re-align the transmitter in accordance with the procedures of the equipment instruction book. 4/1/50

ADJUSTMENT OF THE AN/ARC-1 RECEIVER'S SENSITIVITY CONTROL

The Sensitivity control, R-274, is a 10,000-ohm potentiometer which varies the grid bias of the rf and if amplifiers of the main channel receiver and rf amplifier of the guard channel. Sensitivity is maximum with minimum resistance; that is, when the control is fully clockwise. It would be fine to have a sensitivity of one or two microvolts all the time except that the listener's ears would suffer until a signal came in to override the ignition and generator hash. Thus it is necessary to back off the sensitivity control just enough to activate the squelch and cut out the noise but not so much as to eliminate weak signals. If the following procedure is used the maximum reception distance will be realized with the minimum discomfort due to noise.

With the radio transmitter-receiver turned on, unlock the SENS Control. Turn on the highest assigned frequency or the channel with the highest noise and, with the GUARD-MAIN switch on the BOTH position, reproduce as far as possible the normal conditions which produce electrical noise. For instance, energize any other rotating or vibrating equipment. Adjust the SENS control for maximum sensitivity by rotating the control shaft completely in a clockwise direction, and then rotate the shaft slowly in a counterclockwise direction until the squelch circuit operates to silence the audio output. Observe the position of the screw-driver slot in the control shaft, and then turn the shaft approximately five degrees farther in a counterclockwise direction. Now lock the control shaft without disturbing the setting.

GENERAL INFORMATION ON THE ADJUSTMENT OF THE RECEIVER OF AN/ARC-1 EQUIPMENT

GUARD CHANNEL: The guard channel is adjusted by the manufacturer for operation on the carrier frequency specified in the contract.

MAIN CHANNEL: The heterodyne-frequency generator was properly set for the ten channels in the process of

tuning the radio transmitter. Since the capacitor which tunes the radio receiver main channel is mechanically ganged to the capacitor which tunes the heterodyne-frequency generator, the radio receiver main channel will be completely tuned when the radio transmitter has been tuned as prescribed above.

TURN SWITCH OFF WHEN REPLACING AN/ARC-1 RADIO SETS

Heavy current flowing in power plugs will melt down and destroy connector pins when poor or intermittent contacts are permitted. This fact, true for any equipment, has been reported as occurring on the receptacle J-401 located at the rear of the mounting rack of the Model AN/ARC-1 Radio Set. The failures are considered to be due to improper installation practice, with the following factors contributing heavily:

(1) In several instances, the transmitter receiver has been removed and installed in the mounting base with the switch inside the front panel cover in the ON position while power is still applied to the mounting base.

(2) Investigation of bent male terminals on the transmitter-receiver reveals that the terminals were engaged by the receptacle J-401 before the untapered sides of the alignment dowels fully engaged the transmitter-receiver. If the transmitter-receiver is not in proper alignment with the mounting base when installation is made, the male terminal will not be engaged properly by the receptacle J-401 and a bent terminal will result.

(3) During the installation of the transmitter-receiver, the wing nuts on the mounting base had been tightened manually in accordance with the instruction book, but had not been safety-wired. Normal vibration had loosened these nuts and had allowed the transmitter-receiver to slide back in the mounting base far enough to lose positive contact with the receptacle J-401.

All maintenance personnel are cautioned to remove the power before replacing the transmitter-receiver, to carefully align the transmitter-receiver with the base before installation, and to secure the wing nuts on the mounting base properly. 4/1/49

REPLACEMENT OF 6AK4 TUBES IN THE AN/ARC-1

The filaments of 6AK5 tubes have the unusual characteristic of decreasing in resistance with usage. Consequently, if a tube is being replaced in an AN/ARC-1 equipment which has been in use for some time, it will also be necessary to replace the tube whose filament is in series with the filament of the bad tube. The second tube can be determined by referring to the schematic diagram in the handbook of maintenance instructions or merely by removing the bad tube from its socket with the equipment turned on and noticing what other 6AK5 tube darkens. The latter method is assuming, of course, that the filament of the bad tube is not burned out. If it is burned out, another 6AK5 will already be dark.

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

If the 6AK5 tubes are not replaced in pairs the tube with the most operating time will have lower filament resistance and cause excessive filament voltage to appear across the new tube with consequent failure.

REMOVAL AND REPLACEMENT OF AN/ARC-1 AUTOTUNE MOTORS

The autotune motors in the AN/ARC-1 transceiver unit may be removed and replaced without the removal of the assembly and more quickly and efficiently than formerly by the following procedure:

(1) Loosen front subpanel, that retains the metering switch, and let it hang on the leads.

(2) Remove the type-832A tube in the final stage.

(3) Obtain a Phillips right-angle wrench, or equivalent, and remove all the motor retaining screws from behind transformer T-104, etc.

(4) Unsolder the motor leads and draw the motor through the front panel.

(5) Replace the motor, using the above steps in reverse order. The method of permanently removing that portion of the framework adjacent to the motor with a hacksaw, is not approved since it weakens the framework of the radio equipment.

AN/ARC-1 () RADIO INTERFERENCE

The Philadelphia Naval Shipyard has conducted a radio survey on Radio Sets AN/ARC-1 () as authorized by Bureau of Ships. The following statements are extracts from the report: Spurious AN/ARC-1 () radiation is of sufficient magnitude to cause intolerable interference to receivers installed on the same ship. All interference of this type was found to be antenna coupled. The most serious problem is second-harmonic energy interfering with UHF receivers. Use of Navy type-53232 antenna filter (used with TDQ) reduced second-harmonic interference to acceptable levels. This filter caused no measurable reduction in signal strength. Conducted, spurious, energy, up to 6000 microvolts, was measured at the power input. This noise was traceable to the dynamotor which caused interference to its own AN/ARC-1 (). The installation of Field Change 3-AN/ARC-1 and Field Change 1-AN/ARC-1A will eliminate all dynamotor interference. Improperly tuned AN/ARC-1 () equipments generate spurious radiation at frequencies in the vicinity of the carrier frequency. Tuning instructions in the Technical Manual (AN 16-30-ARC-3) should be followed closely.

MODEL AN/ARC-1 TROUBLE SHOOTING NOTES

Difficulty Encountered

AN/ARC-1-Transmitter and receiver readings low: Transmitter and receiver intermittently becoming inoperative a short time after switching to a new channel.

Cause and Remedy

Replaced V-102, 103, 114, 124 (all 6AK5's. Old tubes found to be very low. U.S.S. Lind (DD-703)

Difficulty Encountered

AN/ARC-1- The channel selector drive motor, B-101, ran continuously for about five hours. This motor was not de-

signed for such continuous operation and heated excessively, causing the insulation of the armature and field windings to melt

Cause and Remedy

The panel spring on the home-stop panel came off. The tip of the panel came up and caught the clutch band, causing the limit relay to stay in one position, thus providing a complete electrical circuit for the motor so that it ran continuously. The panel spring is hooked to one of the screws holding the limit relay in place. The motor was replaced and a drop of solder was put over the screw to keep the spring in place.

Difficulty Encountered

AN/ARC-1-On checking, it was found that the filament voltage of V-107 had increased to 13.5 volts and the filament voltage of V-106 was zero.

Cause and Remedy

Capacitor C-327 in the receiver section was shorted. Replaced and resumed normal operation.

A.C. POWER SUPPLY FOR AN/ARC-1 AVAILABLE WITHOUT REIMBURSEMENT

The Bureau of Ships has in stock a quantity of PP-903/U Rectifier Power Units which provide high and low-voltage power requirements for AN/ARC-1 when operated from 117 volts a.c. These units are furnished in a cabinet 27-inches long, 19-inches wide, and 12-inches high (including shock mounts), but they may be rack-mounted in a CY-597/G cabinet. The weight of the unit is 144 pounds. NAVSHIPS 91761 is the Technical Manual for PP-903/U Rectifier Power Unit. These units are available, without reimbursement, to activities forwarding shipment requests to the Bureau of Ships.

AN/ARC-1, AN/ARC-1A

Failures in Power Supply

An analysis of recent failure reports submitted to the Bureau of Ships has indicated repeated failures of capacitors C3 (16 mfd, 660wv) and C4 (8mfd, 600wv) in Power Supply PP-1092/U.

It has been determined that these failures are caused by the slow heating of the cathodes in the 6AU5 voltage-regulator tubes V5, V6, V7 and V8, as compared to the faster heating of the filaments in the 5U4G rectifier tubes V2 and V3. The estimated time differential is about three seconds. During these three seconds, the filtered, unregulated portion of the power supply operates with practically open terminals, except for a very small load imposed by resistor R3 and tube V9(OA2) which is not sufficient to hold the voltage within limits of the capacitor ratings. The cathode of the 6AG5 (V10) heats somewhat faster than the cathodes of the 6AU5's, however, this tube by its characteristics and function as a control tube, does not provide any appreciable load for the unregulated supply.

The Bureau of Ships is investigating a time delay (thermal type) relay for application in the primary of transformer 2 to permit all tube heaters and cathodes to arrive at proper operating temperature before application of high voltage.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****AN/ARC-27 SHOCK HAZARD**

When operating Radio Set AN/ARC-27 on the bench, electronic technicians have been shocked by contact with the dynamotor. Investigation has shown that the shock-mounted dynamotor was not grounded to the set chassis and leakage current from the high-voltage side causing the entire dynamotor assembly to be about 250 volts above ground. The offending dynamotor was disassembled, revealing an accumulation of dirt, carbon dust, and copper dust in the high-voltage side. An ohmmeter check revealed a resistance of only 0.1 megohm from the brush holder to the frame.

After thoroughly cleaning the dynamotor, the resistance from brush holder to frame increased beyond the range of the ohmmeter.

In other cases where this condition existed, arcing had been occurring from the high-voltage brush holder to the dynamotor frame, charring the surface of the insulation.

To prevent damage to the equipment and to safeguard technicians, the dynamotor in Radio Set AN/ARC-27 should be cleaned whenever the equipment is on the test bench, or at least every 60 hours of operation as required by the equipment Preventive Maintenance Instructions.

USE OF 150 MA PANEL LAMP FOR ANTENNA TUNING

As a result of information forwarded to the Bureau of Ships, the following procedure is recommended for use by ships force personnel in accomplishing Field Change 1-AN/CRT-3 or for general testing of the equipment. Field Change Bulletin, NAVSHIPS 98393, specifies that a 0-150 ma r-f meter be supplied by the installing activity for testing the equipment. This type meter may not always be readily available. In lieu of the meter, a 150 ma Mazda Type 47 (brown bead) panel lamp can be used.

In step (10) of Field Change 1-AN/CRT-3, instead of showing r-f current on the meter, the panel lamp should light when the Hand Crank CG-18A is being turned. Proceed with step (11). In step (11b), the capacitor C-116 should be adjusted for maximum brilliance of the panel

lamp. After accomplishing step (11c), again check for comparable brilliance as in step (11b).

The use of the Mazda Type 47 panel lamp is a substitute method for use only when a suitable 0-150 ma or equivalent meter is not available. The use of a meter is preferred.

TESTING AN/CRT-3

Navy and Air Force rescue efforts in response to distress signals have been fruitless because the signals have originated from AN/CRT-3 or similar emergency equipment being tested. Under no circumstances is the AN/CRT-3 equipment to be tested or operated under conditions other than emergencies without substituting an appropriate dummy load for the antenna. Maintenance personnel should refer to Section V of the equipment instruction book for information on the required dummy antenna for testing the AN/CRT-3 equipment.

AN/FCC-3 CARRIER-TELEGRAPH TERMINAL EQUIPMENT

The Bureau of Ships has received numerous requests from field activities for information on the AN/FCC-3 Carrier Telegraph-Terminal equipment to facilitate planning on new construction projects. Design characteristics are believed sufficiently firm for the following information to be used pending general distribution of installation drawings and operational information.

Basically, the AN/FCC-3, is a combined narrow and wide-band telegraph-terminal equipment, and may be operated over any good quality voice channel radio link or wire line having a loss not exceeding 30dbm. The equipment is housed in two relay rack cabinets of the same construction and dimensions as the standard Navy type CY 597A/G but with minor internal modifications. One cabinet contains the transmitting group or send equipment, and the second cabinet, the receive group or receiving equipment.

The transmitting group consists of eight narrow-band 85-cycle frequency-shift-channel oscillators with mid-band frequencies between 425 and 1615 cycles per second with 170 cycle frequency-shift channel oscillators with frequencies of 1955, 2380, 2805 and 3230 cycles. The narrow-band channels are capable of handling a keying rate of 40-dot cycles per second; and the wide-band channels, a rate of 100-dot cycles per second. The channel oscillator or transmitter is keyed from a 20 to 60-ma neutral-telegraph loop with battery supplied from either the loop, the transmitter, or a 30-ma polar-telegraph loop with battery supplied from the loop. The outputs from the transmitters are combined for transmission over a single-voice channel having a nominal input impedance of 600 ohm.

The receive group consists of eight narrow-band and four wide-band receivers or demodulators for converting the tones to direct current for operating telegraph or teletype equipment. The dc output is capable of keying a 20 to 60-ma neutral loop with battery supplied either from the loop, the receiver, or a 30-ma polar loop with battery supplied from the receiver.

An additional modulator or converter is provided in the transmitter for translating the eight narrow-band channels to a frequency spectrum of from 1700 to 3060 cycles. Information on the use of this facility will be forwarded to the field by the Bureau at a later date.

External wiring to the transmitting group normally requires a single-phase 115 or 230-volt, 1125-watt circuit for power, 12 signal circuits for dc telegraph loops, and one audio-signal circuit for the combined output of the transmitters. A similar number of circuits is required for the receiver group, except for a power requirement of 1770 watts. Type plans for installation, when completed by the Bureau, will require individual signal circuits from the audio output of each transmitter to a jackfield or patch board in the supervisory area to facilitate testing and provide flexibility in the use of the equipment. Combining of the outputs will be accomplished by strapping on the main distributing frame instead of within the terminal equipment cabinet. The total number of audio-signal circuits required then becomes 15, including the input and output of the group modulator. Similarly the input to the receiver will be terminated in the

jack field in order that receivers may be removed from a circuit by patching.

Each unit of the equipment except the power distribution unit is mounted on a drawer-type slide permitting the chassis to be pulled out and tilted, bottom side out, for servicing. The chassis may be removed from the cabinet by disconnecting the power and signal-cable connectors and lifting it out.

AN/FCC-3 TELEGRAPH-TERMINAL EQUIPMENT

A report of recent studies by Aeronautical Radio, Incorporated, indicates that a substantial increase in the life of rectifier tubes in the AN/FCC-3 Telegraph-Terminal Equipment can be obtained by using ruggedized tubes. Accordingly, use of type 5Y3WGT or 5Y3GTB is authorized as replacement for 5Y3GT tubes in this equipment.

AN/FCC-3, -7, -8 HEAT PROBLEM

To alleviate maintenance problems in the AN/FCC-3, -7, -8, caused by excessive heating, the installation of a commercial blower unit, such as Model 2E408 manufactured by the McLean Engineering Laboratories, of Princeton, New Jersey, is authorized. For maximum cooling, the method of installation is important: (A) mount the 2E408 unit in place of the existing seven-inch blank panel at the bottom of the AN/FCC-3, -7, -8 cabinets (B) close the air outlet in the top of the cabinet and disconnect the existing exhaust fan. The new blower pressurizes the cabinet with filtered air which escapes through existing openings in each equipment drawer. Cost is on the order of \$75. No field change covering air circulation in the AN/FCC-3, -7, -8 is planned.

AN/FCC-3, -7, -8 AND UQ REPAIR PARTS ALLOWANCES

The Telegraph-Carrier Terminals AN/FCC-3, AN/FCC-7 and AN/FCC-8 and the Radio-Relay Link Equipment, model UQ, when placed on the allowance of a communication station by the Chief of Naval Operations, are normally assigned to the parent activity for accountability. Since these equipments are utilized on a system basis and consist of a number of transmitter and receiver units or groups, it may be necessary to install several units or groups in different locations.

In those cases where incomplete equipments are installed each new activity, when requesting repair parts allowances from the Electronic Supply Officer, Great Lakes, should list only the type designations of the units or groups actually installed at the activity in lieu of listing the model designation of the complete equipment. An example is as follows:

Quantity	Description
1	T-371/FCC-3
1	R-525/FCC-3
1	OA-504/FRC

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

Stock number identification tables are being prepared by the Electronic Supply Office, Great Lakes for the AN/FCC-3 as a complete equipment as well as for the major units of the AN/FCC-3, AN/FCC-7 and AN/FCC-8. Such tables are also being prepared for the major groups of the UQ equipment.

Telegraph Carrier Terminal, AN/FCC-3A and AN/FCC-7A

These equipments have been designed to permit ready access for testing and repairs, without removal of the individual units from their cabinets. The circuits are grounded

to the chassis for adequate protection against accidental electric shock.

However, if the units are removed to a test bench or otherwise detached for testing, the chassis of the detached unit should be provided with a good ground connection to minimize shock hazard.

REPLACEMENT COAXIAL CABLES AND CONNECTORS FOR THE AN/FGC-1A KEYER

In order to improve the reliability and availability of coaxial cable and connectors used on and with the AN/FGC-1A frequency shift keyer, a change has been made to a more standard Army-Navy type. Whenever the cables and connectors of the older type become defective, they should be replaced with the following:

(1) Wherever the H. B. Jones S-101 receptacle is used, the Navy type 49194 receptacle and Navy type 49193 receptacle hood should be substituted therefor.

(2) Wherever the H. B. Jones P-101 ¼ plug is used, the Navy type 49195 plug should be substituted therefor.

(3) Wherever the Western Electric Company, code KS-8086 coaxial cable (Army-Navy type RG-39/U) is used, the Army-Navy type RG-8/U coaxial cable should be substituted therefor.

MODIFICATIONS TO AN/FGC-1A AND AN/FGC-1B EQUIPMENTS

Reports have been received concerning the overheating and melting of compound from the 34A varistors (part No. CR-901 and CR-902) on the detector panel CW-50133 of the frequency monitoring assembly bay of the AN/FGC-1A and AN/FGC-1B radio equipments. This condition is caused by the fact that the two varistors are located too close to the 6V6G detector tubes and to the flat resistors R-915 to R-919.

This situation should be corrected by mounting the varistors in the same relative location on the rear of the

mounting panel. Each varistor is mounted by using two 1-inch brass spacers ¼" in diameter and drilled with a #29 drill and tapped with an 8-32 tap. The two spacers are fastened to the mounting panel by 8/32 ½-inch round head machine screws through a 1½" x ¾" metal mounting plate in which there are two holes drilled 1 1/16" apart with a #19 drill. Reconnection can be made without disturbing the leads.

REPLACEMENT OF ELECTRONIC TIMERS IN AN/FGC-1, AN/FGC-1A, AN/FGC-1B, AND UF TELETYPE AND TONE EQUIPMENTS

The Bureau of Ships has available a quantity of electronic timers, Western Electric type KS-15206 (List 1), procured under contract NOBsr-30097, which will be issued on request to the Bureau. These timers are to replace similar mechanical timers, utilized at present in models UF, AN/FGC-1, AN/FGC-1A, and AN/FGC-1B terminal equipments, wherever difficulties and failures warrant the substitution. In these equipments, damage to the rectifier tube results from failure of the old-style timers. Four timers are used in each model UF, and one in each of the AN/FGC-1, AN/FGC-1A, and AN/FGC-1B units. The Bureau will supply additional station spares, upon request, in amounts based on the total number of timers in use at any one location. It is requested that recommendations for spare timers include a statement of the total number of timers in use at each location. Adequate amounts of stock spares will be maintained by the Bureau at Naval Supply Depots.

AN/FGC-5 MODIFICATION FOR POLAR OUTPUT FROM RECEIVING CODE CONVERTER

Bureau of Ships drawing RE 10 C 2113 A outlines the procedure necessary to obtain polar output from the CV-94/FGC-5 receiving code converters. This modification is recommended where the teletype signal from the AN/FGC-5 receiving terminal must be transmitted over a land line not suitable for neutral keying.

Where this modification is made, it is directed that a copy of the modification be kept with the modified equipment. Also, any AN/FGC-5 equipment so modified must be returned to its original condition if, for any reason, it is returned to stock.

AN/FGC-5 SERVICING NOTES

The Bureau of Ships forwarded Electronic-Equipment Failure Reports to the Teletype Corporation, manufacturer of the AN/FGC-5 Electronic Multiplex equipment, for analysis and comment. As a result, the following recommendations support the need for conscientious reporting of failures by field activities. The Teletype Corporation indicated that it could not comment on the failure of components manufactured by other concerns, but these recommendations have been found to improve the overall operation of the AN/FGC-5.

1. The instruction book for the Telegraph-Terminal Set AN/PGM-1 (NAVSHIPS 91945) details a procedure for checking the plate-voltage range of tubes in the AN/FGC-5 equipment. The contractor recommends that generally the tubes not be replaced, except in the Oscilloscope, if their associated circuit is functioning properly. Tubes, whose emission has fallen as low as forty percent of maximum, have been found to operate satisfactorily in properly aligned circuits.

2. Pages 3-3 to 3-5 of the instruction book, noted above, describe a simple way of checking the operation of the tuned

circuit associated with the first frequency divider in the Signal-Distributor Drive Units (0-101 and 0-100/FGC-5).

The coils in these tuned circuits tend to change value and eventually it becomes difficult to find a type 6SN7 tube that will operate properly in this circuit. Replacing the associated capacitor, instead of the coil, will clear up the trouble. Proper replacement of these capacitors often makes replacement of the associated oscillator tube unnecessary.

3. A capacitor decade box is recommended for precise checking of all the frequency dividers. Proceed as follows:

a. Remove the tuning capacitor, or capacitors, from the divider tank circuit.

b. Connect the decade box to the tank circuit using leads as short as possible.

c. Determine the capacitance that drives the circuit out of operation (both the minimum and maximum values).

d. Replace the tuning capacitor, or capacitors, with a capacitor equal to the average value found in step (c) above.

4. If the external battery-voltage-regulator circuit (Receiving-Control Monitor Unit C-625/FGC-5) is not used, removing tubes V317, V318, and V319 will reduce heat dissipation, and increase the life of the remaining tube.

5. The failure reports (other than tube failures) were largely concerned with resistors located in the oscilloscope unit. New rear doors will reduce these types of failures and generally improve the operation of this unit. (EIB No. 395 provides ordering information on the doors).

6. Page 7-70 of the instruction book for the AN/FGC-5 equipment (NAVSHIPS 91265A) indicates the adjustments that should be made following the replacement of certain critical tubes. Particular attention should be given this section to insure both proper operation and longer tube life.

The Bureau is appreciative of the cooperation on the part of the Teletype Corporation and urges each technician to assume a personal responsibility in filling out and forwarding failure reports promptly.

AN/FGC-9, AN/FGC-10 PROTECTIVE SHIELDS

The use of light aluminum shields on the AN/FGC-9 and AN/FGC-10 Teletypewriter Sets as an aid in keeping the mechanism clean has been suggested.

The vertical position of the selector leaf, sword, and associated T-lever mechanism allows paper fuzz and dust to work directly into the selector, adding mechanical drag

to the bell crank and armature extension action. The suggester believes that the working efficiency and margin can be materially extended by the installation of these shields.

In addition to the material required in Figures 1 and 2, two (6-40 Hex Nuts) Teletype Parts, Number 3606, are required also.

The Bureau does not recommend this procedure as a general modification by field change to all equipments but rather as an optional modification to equipments handling a high volume of traffic.

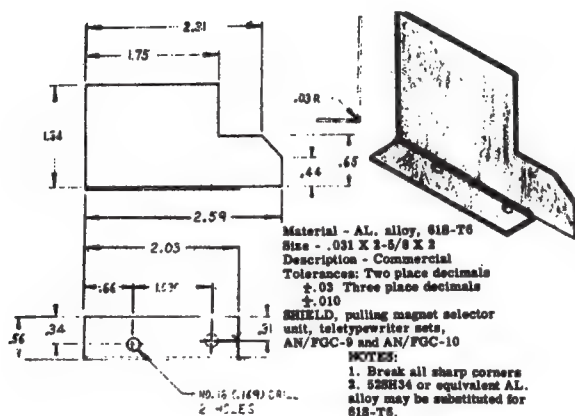


FIGURE 1

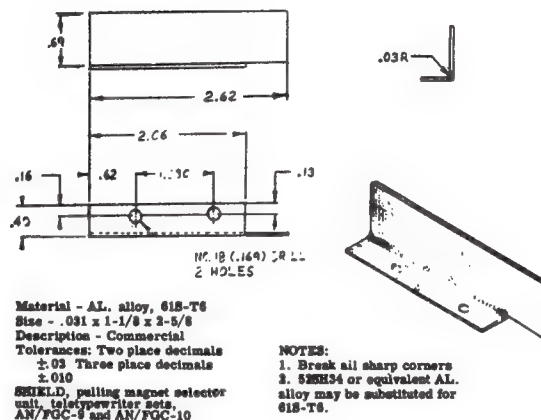


FIGURE 2

COMMENTS ON RADIOSONDE RECEPTOR AN/FMQ-2

1. Field Change No. 1-AN/FMQ-2 for modification of pulse shaping circuits of Radiosonde Receiver R-228/FMQ-2 is available and should be requested from Bureau of Ships and incorporated in all R-228/FMQ-2 receivers supplied under Contract NObsr-42380.

The above modification was incorporated into all R-228/FMQ-2 receivers supplied under Contract NObsr-52193 by the contractor.

The temporary corrections T-1 and T-2 to Complementary Technical Manual for Radiosonde Receptor AN/FMQ-2, NAVSHIPS 91266 (A) are required for all instruction books regardless of the contract under which the R-228/FMQ-2 receivers were procured.

2. The Radiosonde Receptor AN/FMQ-2 is the new nomenclature assigned to the AN/FMQ-1, AN/FMQ-1A and Model RAU series receptors which have been converted to operate with pulse modulated 403 megacycle radiosondes instead of 72 megacycle amplitude modulated radiosondes. Conversion is accomplished by replacing the 72 megacycle receiver and antenna with Radiosonde Receiver R-228/FMQ-2 and Antenna Assembly AS-389/FMQ-2.

Ships and activities should request a new rack nameplate from the Bureau of Ships when a receptor of the

type described in the above paragraph is converted to an AN/FMQ-2 receptor. Since the serial number of the R-228/FMQ-2 receiver will determine the serial number of the new rack nameplate, both contract and serial number of the receiver should be submitted with the request.

3. The RD-3 ()/FMQ series recorders and the TS-29 () FMQ-1 series frequency meters used with the radiosonde receptors are very precise units and require proper calibration before an accurate translation to meteorological values can be made. Reports from shore activities and ships indicate that the calibration procedures are not being properly followed. The procedure, as outlined in NAVSHIPS 91303, Technical Manual for AF Signal Generator SG-21/U, Section 3, is the preferred method when conducting the alignment and calibration of the frequency meter and recorder and is considered adequate for this purpose.

If the above-mentioned instruction book is not available, reference may be made to:

TM 11-2434; TO16-30FMQ2-6 Radiosonde Receptor AN/FMQ-2 Pages 95-98. TM-2403; AFM100-55 Radiosonde Receptors AN/FMQ-1 and 1A. Pages 87-95.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****AN/FRA-501 Maintenance Notes**

It has been reported that a decrease in resistance of R-45, a part of C-5027/FRA-501 through C-5031/FRA-501, caused a failure of the output transformer (T-5 of these

units) and of the power transformer T-1 of PP-5030/FRA-501). To prevent such failures, the resistance of R-45 should be measured at each preventive maintenance inspection. Replacement should be made when the resistance decreases to 600 ohms.

ORIGINAL**AN/FRA-501:1**

Filter Choke L-109, P/O AN/FRC-6 and -6A

Filter choke L-109, FSN N5950-647-6330, previously stocked as the replacement choke for L-109, in the naval supply system, was rated at 1.75 henries and when installed created excessive hum. The correct values for L-109, P/O AN/FRC-6 and -6A are 2.5 henry and 1.9 henry respectively. Accordingly, when ordering replacement chokes for L-109, the following Federal Stock Numbers apply; N5950-245-9657, P/O T-215A/FRC-6, and N5950-231-1939, P/O T-264/FRC-6A.

AN/FRC-6, -6A, -51 POWER SUPPLY FAILURE

Report that on numerous occasions various field activities have experienced failures of the 5U4G rectifiers, V-109 and V-110, as well as the 5-ampere, 125-volt primary-line fuse, F-101. It was indicated that at most activities, line voltages vary between 115 and 125 volts creating high-inverse peak voltages which, over a period of time, caused the 5U4's to arc-over and blow the 5-ampere fuse. Since the 5R4WGB has a higher inverse-peak-voltage rating than the 5U4G, the 5R4WGB was installed plus a line variac to maintain a line voltage of 110 volts which eliminated the above failures. It is therefore the recommendation of the Bureau that all activities, experiencing similar difficulties, should replace V-109 and V-110 with the type 5R4WGB tubes and incorporate either a variac-type of voltage-regulating transformer or a Solar-type of line-regulating transformer, whichever is more feasible depending on the frequency of variations. If, as a result of the foregoing recommendations, the 5U4's are replaced with the 5R4WGB tubes; this change is to be reflected on the station's equipment-history cards and associated technical manuals.

AN/FRC-6, AN/VRC-2 MICROPHONE DISTORTION

Operational tests, recently conducted on the above equipments, proved conclusively that problems of overmodulation, distortion, and reduced range was the direct result of the use of an improper M-27A/U. The use of this microphone results in a much higher input voltage to the transmitter than is required for proper frequency deviation, due to its 100-ohm impedance characteristic. The M-27/U has a 50-ohm impedance and functions properly. Therefore, it is recommended that M-27/U be used in all series of the above equipments in lieu of the M-27A/U.

AN/FRC-6, AN/VRC-2 SUBSTITUTION OF 6K8 TUBES IN LIEU OF 6K8GT

Type 6K8 Electron Tubes may be used in lieu of the type 6K8GT in AN/FRC-6 series equipments and AN/VRC-2 series equipments. When the 6K8 is used in lieu of the 6K8GT, the equipments should be realigned to insure optimum performance.

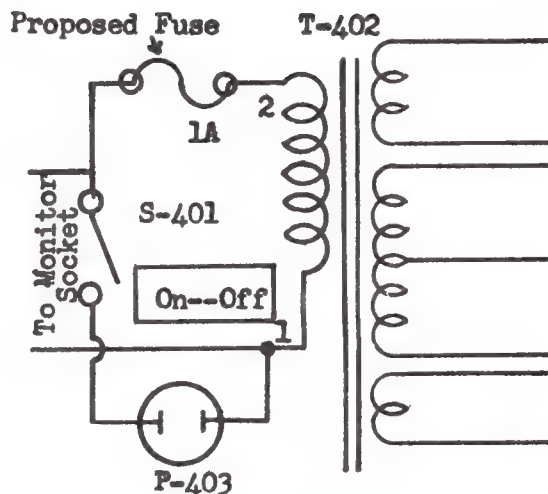


Figure 1

CONSOLE C-599 AN/FRC-6

It has been suggested that a 1-ampere fuse in series with the primary winding of T-402 be placed as an overload protection. In favorably commenting on this suggestion, the Bureau points out that such a fuse was incorporated in later models of the C-599A/FRC-6.

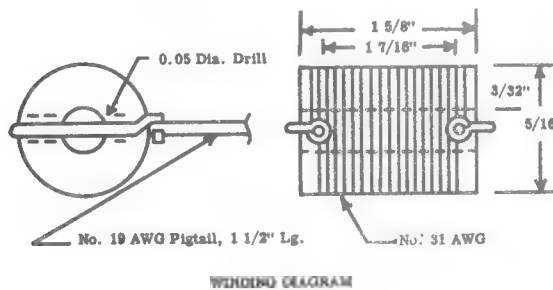
Activities having unfused models should install this overload protection by using Fuse N17F-16032-0080 and Fuse Holder N17F-74267-5401 as shown below.

AN/FRC-6A SUPPLY INFORMATION

The Naval Supply Depot, Clearfield, has reported that a number of AN/FRC-6A equipments were received from contract without the Antenna Cable Assembly. Activities which do not receive this Cable Assembly (consisting of one each RF cable, type RG-59A/U, three feet long, SNSN N15-C-12201-0528, and two each connector plugs, RF, Type UG-260/U, SNSN N17-C-71408-3425) should requisition the individual items through normal supply channels. The catalog prices for these items are: 3-ft. cable @\$0.06 per foot, \$0.18 and two connector plugs @\$0.93 each, \$1.86 for a total price of \$2.04.

AN/FRR-28 REPLACEMENT FILAMENT CHOKE

A more rugged version of the filament choke (L2-49) has been developed at INDMAN 14. Activities encountering failures of the original filament choke may utilize the following construction details to fabricate the heavy-duty replacement choke. When the replacement choke is used, be sure to include this information in the equipment instruction book as a permanent record.



* Maximum temperature rise 35.1° Cent.

Construction Data:

Designation Symbol - L2-49 modified Filament Choke Winding - No. 31 AWG resin covered wire, stock no. GX6145-190-6959, 155 turns, single layer, close wound Electrical-DC resistance 1.67 ohms, 28.5 uh, at 70° fahrenheit. *

Form - 1/2-inch ID, 5/16-inch OD Electrical-Insulation Sleeve, stock no. GR-5970-221-5790. No. 19 AWG tinned-copper pigtails added.

Installation Data:

In R-450/FRR-28 Radio Receiver, remove T1 cover (refer to NAVSHIPS 91582 fig. 7-3). Unsolder all leads running to adjacent RF strip. Remove screws holding RF Strip in place. Only one coax cable now prevents complete removal of RF Strip from R-450/FRR-28 Radio Receiver. The cable is long enough to allow RF Strip to be turned over. Turn over RF strip. Unsolder and remove L2-49 (refer to NAVSHIPS 91582 FIG. 7-6). Solder the above L2-49 Modified Filament Choke in place of the original L2-49, replace RF Strip.

KY-44C/FX, KY-45B/FRT-5 AND MD-200/FRT KEYER MODIFICATION

The KY-44C/FX facsimile keyers are designed to work into a 600-ohm load and are used to control the KY-45B/FRT and MD-200/FRT (components of the AN/FRT-5B and AN/FRT-18 Radio Transmitting Sets, respectively) frequency-shift keyers.

The KY-45B/FRT-5 and MD-200/FRT each provide for 600-ohm termination for the KY-44C/FX facsimile keyer by shunting a 630-ohm resistor across a series combination of 8,200 ohms and 5,000 ohms, thus permitting a load of only one transmitter per facsimile keyer. Where the same facsimile transmission is broadcast on two or more frequencies simultaneously, it is necessary to use one KY-44C/FX facsimile keyer per transmitter. U. S. Naval Radio Station (T) Kodiak has determined that this problem can be corrected by installing a 1-watt, 680-ohm resistor across the output terminals of the KY-44C/FX keyers and removing the 630-ohm terminating resistor in both the KY-45B/FRT-5 and the MD-200/FRT frequency-shift keyers. This modification presents a 646-ohm load to the facsimile keyer when keying one transmitter and a 541-ohm load when keying five transmitters simultaneously. The operational problem of adjusting multiple keyers for a single, multi-frequency facsimile broadcast has been eliminated. This arrangement has been used by U. S. Naval Radio Station (T) Kodiak with very satisfactory results. Other U. S. Naval Radio Stations (T), experiencing similar difficulties, are authorized to modify their keyers and record the modification on the Electronic Equipment History Cards.

RADIO TRANSMITTING SETS AN/FRT-5(), AN/FRT-6() DISCREPANCY IN RF OSCILLATOR 0-91() /FRT-5 AND TECHNICAL MANUALS

A discrepancy has been noted in the harmonic oscillator circuit of several RF Oscillators 0-91() /FRT-5 and in corresponding portions of appropriate technical manuals. In addition to the 39-ohm resistor (R125) between the screen grid of the harmonic oscillator 6AK5 (pin 6 of V104) to ground, there should be a 6.8-ohm resistor (R245) between pin V104 and the positive 150-volt, regulated power supply. The screen grid then assumes a positive potential of 120-volts, rather than 0, 12 or 82-volts recorded in the various technical manuals. THE EQUIPMENTS SHOULD BE CHECKED AND CORRECTED where necessary to assure proper operation in the AFC circuits of this oscillator.

The schematic diagrams of the RF Oscillator 0-91() /FRT-5 included in the AN/FRT-5A, -5B, -6A, and -6B Technical Manuals indicate the suppressor grid on the 5686 as being grounded. Actually, the suppressor grid on the 5686 tube is internally tied to the cathode and will assume the cathode voltage.

PP-490() /FRT-5, POWER SUPPLY FILTER ASSEMBLIES

The two air filter assemblies, which mount on the rear doors of the PP-490() /FRT-5 power supplies, can be in-

advertently interchanged during preventive maintenance periods. Should these filters be interchanged, the filter air ports will not align with the air-suction port. This results in a great restriction of the air intake for the B-301 blower and causes over-heating of the power supply.

It is suggested that the filter cover plate on the right door be slotted and a pilot pin consisting of a 6-32 machine screw and nut be employed as shown in Figure 1.

MODIFICATION OF TUBE EXTRACTOR USED TO REMOVE INTERMEDIATE POWER AMPLIFIER TUBES OF RADIO TRANSMITTING SETS AN/FRT-5 AND AN/FRT-6

The purpose of this tool modification is to provide an improved tube extractor, preventing injury to the technician and damage to the equipment.

This tool may be modified as suggested by any using activity which has experienced difficulty in using the tool as supplied.

NOTE: The tube extractor furnished with the equipment is used for removal of the two 3X2500A tubes from the T-225/FRT-5 series RF unit. This modification of the original extractor was devised and tested at the Naval Radio Station at Lualualei, Hawaii. It has proven satisfactory in service and is recommended for accomplishment by activities experiencing difficulty with the extractor furnished with the equipment.

PROCEDURE:

1. The following parts, shown in figures 1, 2, 3, and 4, are needed for this modification and must be fabricated or obtained locally:
 - 1 Knob, drilled to clear bolt (below) (A).
 - 1 Bolt, at least 4 inches long and 3/8 inch in diameter (B).
 - 2 Hexagonal nuts for bolt (above) (C).
 - 1 Crosspiece (D).
 - 2 Legs (E).
 - 1 Yoke, drilled to clear bolt (above) (F).
 - 2 sleeves (G).
 - 2 Links (H).
 - 1 Positioning plate (formed from 1/16-inch sheet steel) (I).
 - 2 Jaws, obtained from original tube extractor or fabricated locally (J).
 - 1 Bottom plate (K).
- Machine screws as needed.

2. Assemble the parts as indicated in the exploded view of the modified tube extractor. The knob is secured to the shaft by the two nuts jammed against it.

USE OF THE MODIFIED TUBE EXTRACTOR:

The modified tube extractor is placed over the tube, bottom plate down, and the knob turned clockwise until the jaws have slid down the sides of the tube cap. Then the knob is turned counter-clockwise until the tube has been pulled free of the socket contacts. The extractor can be removed from the tube by raising the positioning plate and wiggling it gently as the tool is raised clear of the tube.

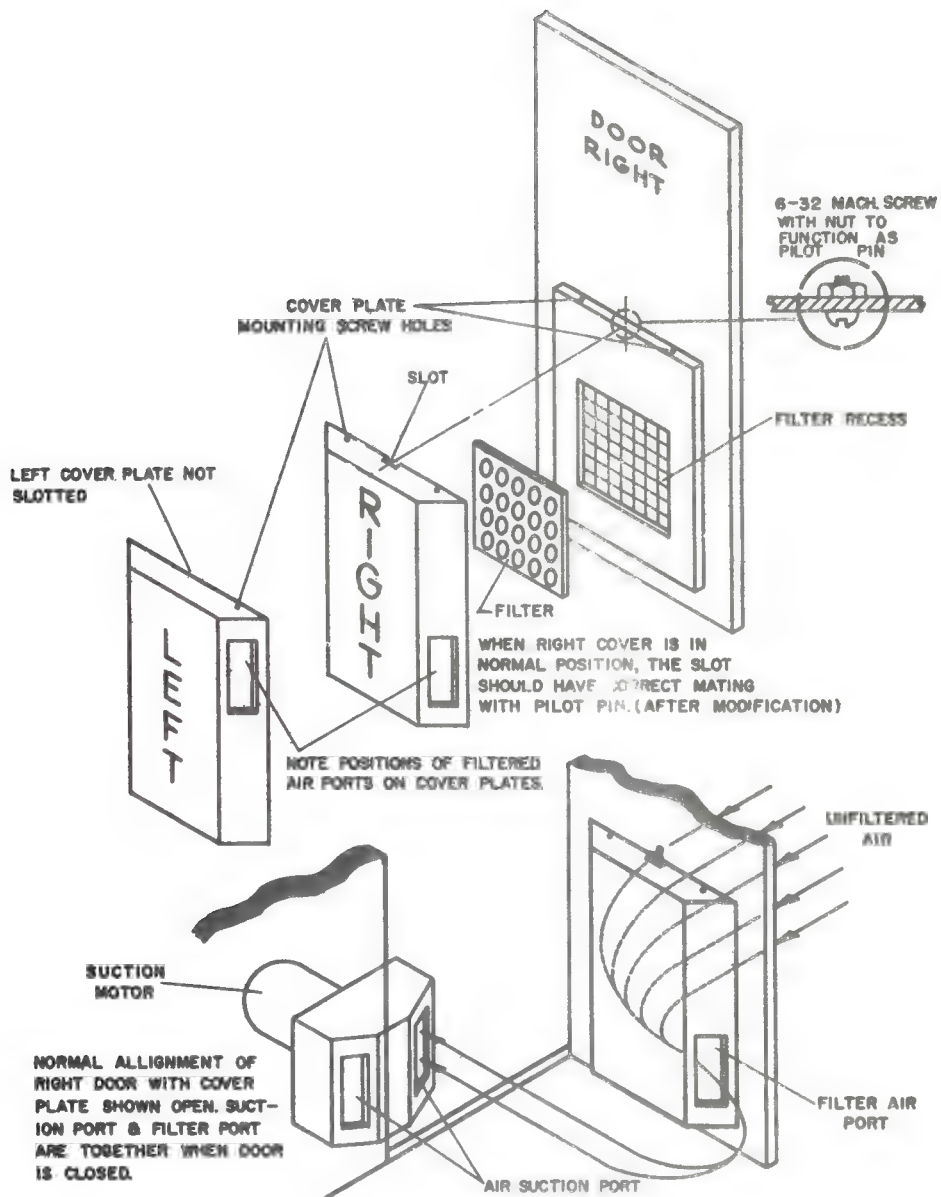


FIGURE 1

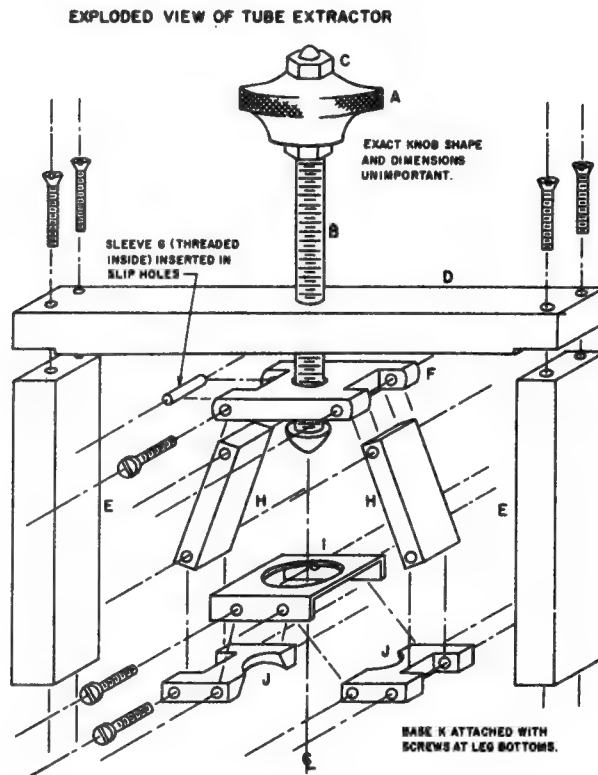


Figure 1

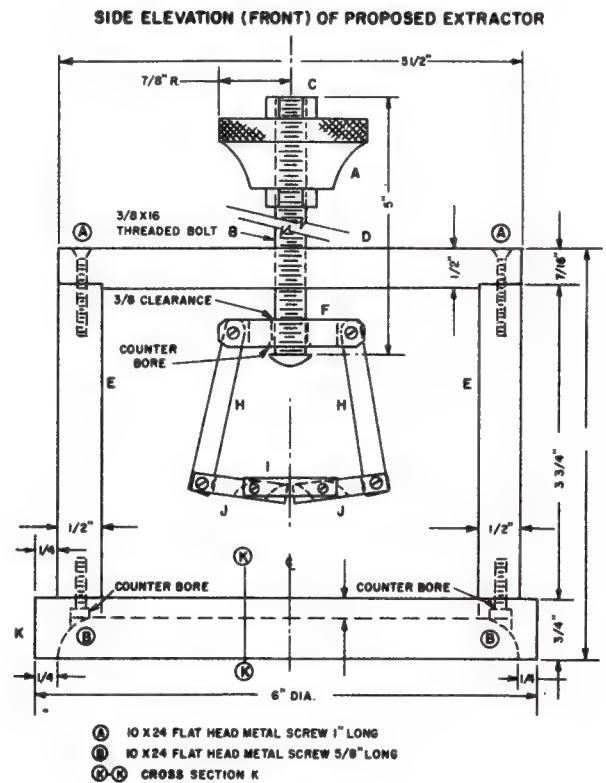


Figure 3

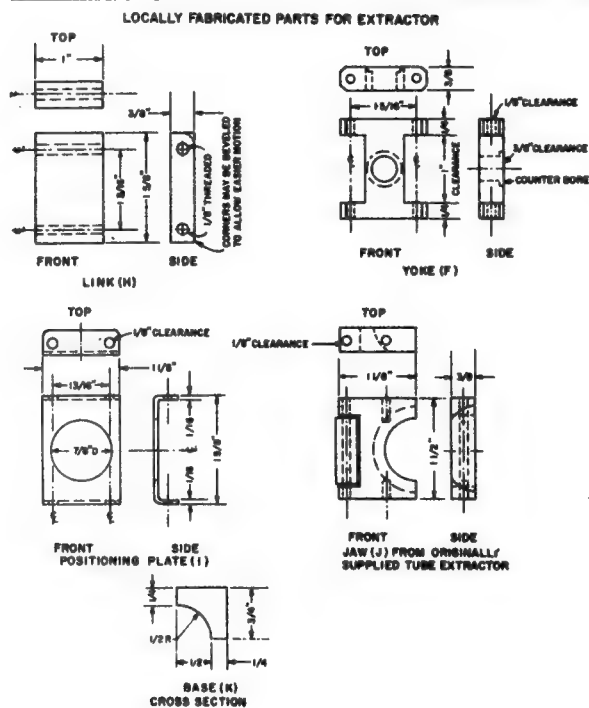


Figure 2

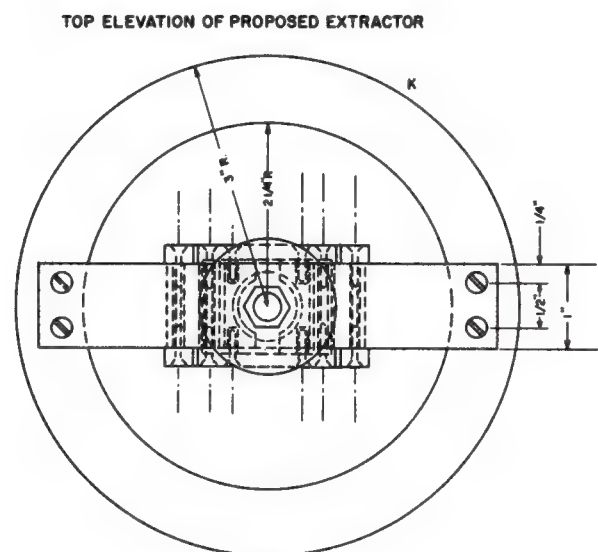


Figure 4

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****RADIO TRANSMITTING SET AN/FRT-6() BURN-OUT OF PA FILAMENT-CHOKES AND CERAMIC GRID CONDENSERS**

Recurring failures of filament chokes and ceramic-grid by-pass condensers in the AN/fRT-6 power amplifier have been traced to the practice of tuning up the 15-kw driver stage without filament power being applied to the 40-kw grounded-grid power amplifier. As a result, the unloaded driver stage develops very high radio-frequency voltages in the "cold" input circuit of the power amplifier causing burnouts. The correct procedure is to apply filament power

to the final amplifier before plate power is applied to the driver stage.

To avoid "pinning" the PA grid-current meter, plate voltage should also be applied to the power amplifier before tuning the driver, making sure that the PA plate current is "dipped" to avoid possible damage to the tubes.

A field change for the AN/FRT-6 series transmitters is being developed which incorporates interlock circuits to automatically provide the above protection. Meanwhile, operating personnel are advised to use care to avoid the conditions causing burn out.

ORIGINAL**AN/FRT-6:1**

AN/FRT-15, -15A RADIO TRANSMITTERS

When using the AN/FRT-15, -15A Transmitters modified by kit RM-193 to feed the unbalanced 70-ohm transmission line, improved operation will result by opening the strap between output terminals E-3002 and E-3003. The revised circuit is as follows:

Correct the diagram in EIB 467, page 3, and Figures 2-9A and 7-95B of Modification Kit RM-193, NAVSHIPS 91690(A)-1 to agree with figure 1.

**Figure 1**

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****AN/FRT-24 RADIO TRANSMITTERS CHANGE IN STOCK NUMBER FOR HIGH VOLTAGE PLATE POWER TRANSFORMER T-401**

Stock Number FSN N5950-629-4434 has been assigned by the Electronics Supply Office to T-401 for AN/FRT-24 Radio Transmitters. This stock number applies to Collins Spec No. 672-0385-00 as revised 20 February 1956 and as manufactured by Chicago Transformer, Spec No. 14947,

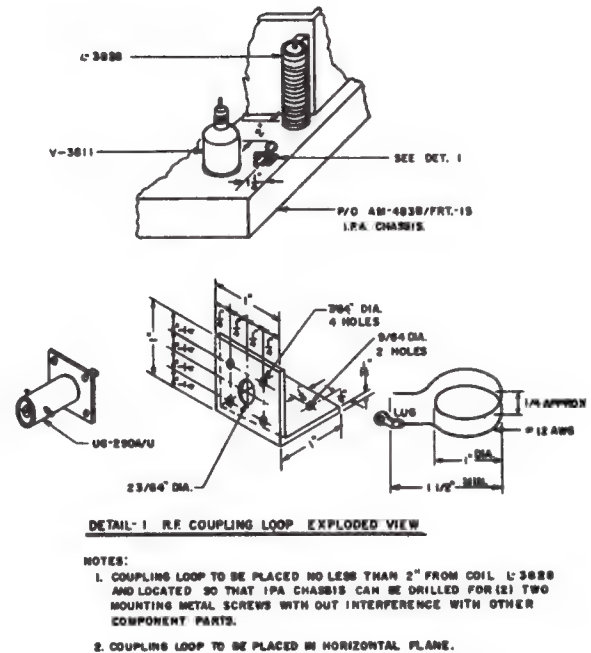
Issue 12. This is an improved version of the original T-401 transformer installed in AN/FRT-24 transmitters bearing serial numbers 1-253 and is expected to exhibit a greatly reduced failure rate.

Future requisitions for replacement T-401 transformers should specify the new stock number since the Electronics Supply Office has initiated action to withdraw from stock the T-401 transformers currently stocked under the old stock number, FSN N5950-647-8564.

ORIGINAL**AN/FRT-24:1**

AN/FRT-25 TRANSMITTER MODIFICATION

Several naval shore-type transmitters, presently in use with an unbalanced coaxial output, do not incorporate facilities for frequency measurements of the actual output energy. The Naval Ship Repair Facility, Guam, has devised a circuit for the AN/FRT-25 which has the Bureau of Ships approval. A small induction loop, Figure 1, is placed near the IPA-plate tank coil - the first point where the output frequency is assured regardless of multiplication factors employed in the transmitter. RF sampling at any of the previous stages would result in measurement of a subharmonic of the output frequency and lesser frequency spread when the transmitter is operated in F1 or F4 modes of emission. This method of RF Sampling may be applicable to other shore type transmitters, provided consideration is given to the power involved which would necessitate a construction change of the induction loop, such as number of turns and spacing from IPA-plate tank coil.

**Figure 1**

AN/GRC-27, Preventing Down Time

A number of AN/GRC-27 equipments have been immobilized by broken contact pins on the special sockets for the two 4X150A tubes (V-601, V-602) in the RF power amplifier. This can result when the tube is replaced and the key on the tube stem is not alined with the guide in the socket. Pushing the tube "home" results in breaking the contacts. Special attention to this situation when replacing tubes is suggested.

AN/GRC-27 AVAILABILITY OF MAINTENANCE REPAIR PARTS

Some activities report lack of maintenance repair parts for Radio Set AN/GRC-27. Spare parts for this equipment were late in delivery for many installations. However, both equipment and stock spares are now available, and all activities are advised to fill their authorized allowance.

A recent report from a ship indicated lack of thermal relay K-901 to affect repair of the equipment. This item is included in both equipment and stock spares for this equipment. It is recommended that all activities carefully check their spare parts allowance and inventory, to avoid unnecessary delay in accomplishing equipment repair.

AN/GRC-27 LUBRICATE HELIPOT R601

Proper lubrication can prevent the Helipot (R601) shaft from freezing in its bearing. This type of mechanical failure has occurred, and results in breakage of the associated flexible shaft coupling (to the tuning drive motor). If such a failure occurs before preventive maintenance can be effected, repair can be made by carefully disassembling the helipot, refinishing the shaft and bearing with corcus cloth, and lubricating the bearing area after reassembly. Replace the shaft coupling if it has broken.

During routine preventive-maintenance procedures, put a drop or two of oil (MIL-L-664) on the shaft bearing of Helipot R601. Helipot R601 is now carried as a stock maintenance item.

IM-89/UR CHECKING AN/GRC-27 TRANSMISSION LINE

The Standing Wave Indicator IM-89/UR can be used in checking the transmission line of AN/GRC-27 by operating the transmitter-receiver at 60 watts and using the "per-

cent reflected power" indication as a measure of the transmission line condition.

C-1180/GRC-27 START-STOP RELAY ADJUSTMENT

Armature chatter in start-stop relay K-105 in Radio Set Control C-1180/GRC-27 has been reported. This relay was changed to a shock-resistant type (Price Electric Company Type 2107), starting with Serial No. 116. The armature return springs are adjusted by the manufacturer so that the relay would close at 100-volts line voltage. When the coil heats up after a short period of operation, the ampere-turns ratio decreases somewhat. This results in a tendency for the springs to open the relay, causing armature chatter. A slight decrease in the spring tension, permitting closure on 90-volts line voltage, will correct this condition.

Radio Set Controls C-1180/GRC-27, Serial 116 through 315, can be adjusted in the field by bending the armature return spring arms (see figure 1) upward slightly. A variable transformer (Variac or similar) should be used when making this adjustment after the relay has cooled for several hours, to obtain relay closure at 90-volts line voltage. If the spring tension is decreased too much, then the relay contacts are sure spt to open under mechanical shock and shut down Radio Set AN/GRC-27.

Radio-Set Controls, Serial 1 through 115, will be field changed to use the new, properly adjusted relay. Stock maintenance relays of the old type will be replaced with the new type.

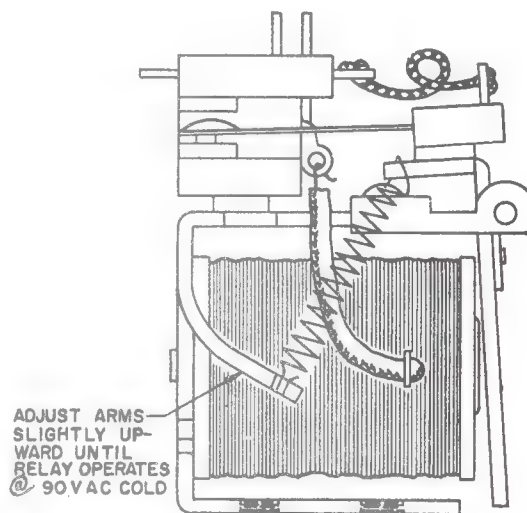


Figure 1

AN/PRC-6 REPLACEMENT CAPACITOR C-43

The replacement capacitor C-43, part of the AN/PRC-6, is too large to be installed in the space allocated. Accordingly, the Electronic Supply Office has initiated action to stock the following capacitor: N5910-726-1384, 15000 μfd ± 10 percent, 100 VDC, molded plastic case. 0.175 inch diameter by 1-1/16 length.

AN/PRC-8, AN/PRC-9, AN/PRC-10 TOOLS FOR SERVICING AND MAINTENANCE

The Bureau has received information from the Signal Corps describing the fabrication of the chassis holder, a fast-tuning knob, a calibration tool, and an alinement tool for servicing and maintenance of AN/PRC-8, AN/PRC-9 and AN/PRC-10 equipments. This information is summarized for use by ships and activities desiring to fabricate these items.

The chassis holder should be fabricated in accordance with Figures 1 and 2. This stand will hold the chassis safely and securely while servicing. It permits easy access to both front and back of the set for metering and checking test points.

The following material is required for fabrication: 4 feet of 1/2-inch angle iron; 1/2-inch steel plate, 10 inches wide x 16 inches long; 3/32-inch steel plate, 2 feet long x 3/4 inch wide; 1-inch steel rod, 6 1/2 inches long. The spring clamp (Signal Corps Stock Number 6Z6918-8) should be either bolted or welded on the two end pieces. (See Figure 3 for completed stand and calibrating tool).

Details of the fast tuning knob, which should be used to turn the tuning knob of the receiver transmitter, are shown in Figure 4. Its use prevents possible injury to fingers,

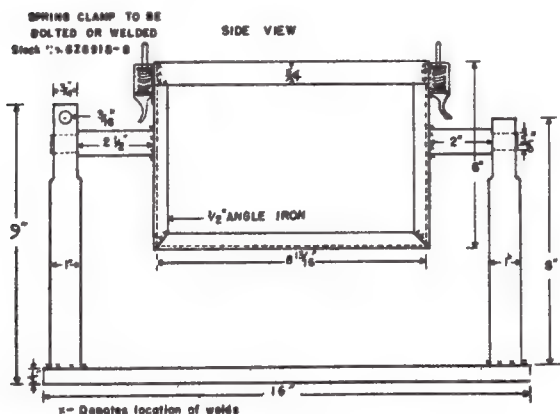


FIGURE - 1

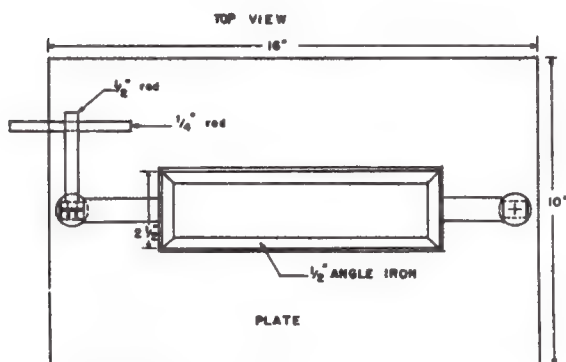


FIGURE - 2

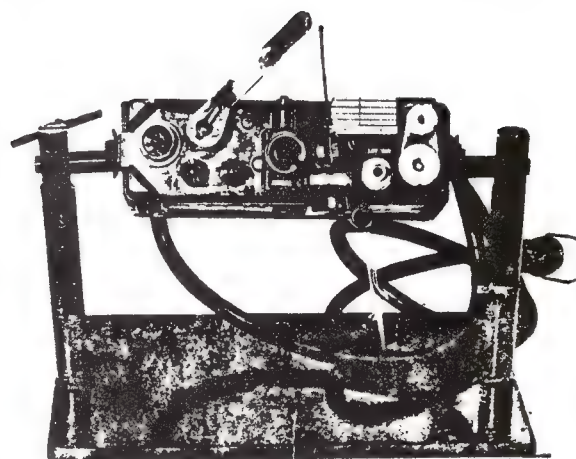
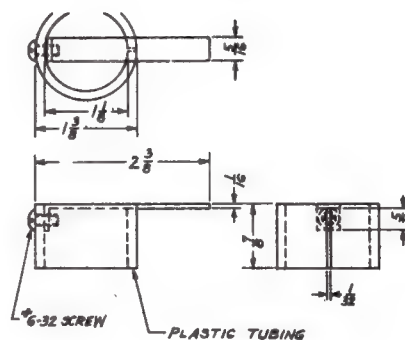


Figure 3



FAST TUNING KNOB

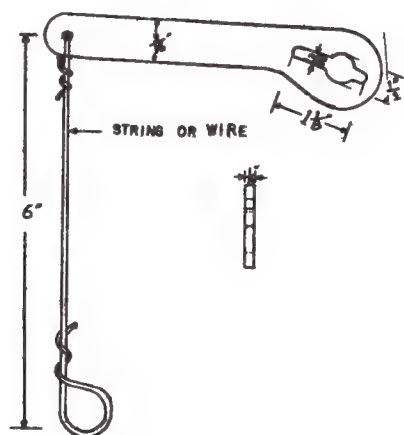
FIGURE - 4

and enables fast tuning from one end of the dial to the other.

The calibrating tool, Figure 5, may be fabricated from 1/8-inch sheet steel, 1 1/4 inches wide x 5 inches long. Use of this tool eliminates the necessity of holding down the calibrate ON-OFF switch by hand. The present practice is to use both hands to calibrate the radio set and to use the chin and shoulder to hold the handset to the ear when tuning.

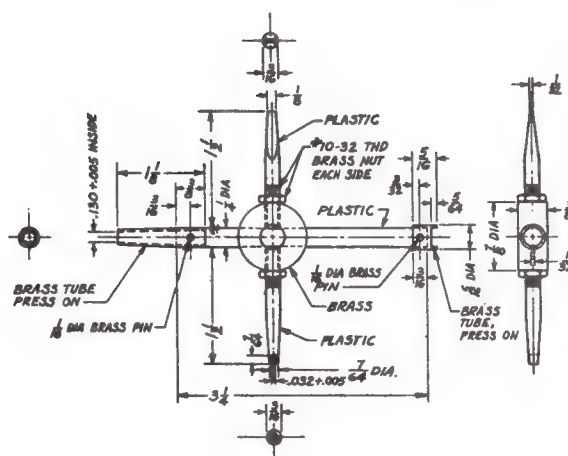
Use of the alinement tool, Figure 6, saves time when servicing the equipment and eliminates the necessity of selecting separate wrenches and screwdrivers. It is a four-in-one tool containing all the individual items required in the alinement procedure.

Based on material published in S.C.E.L. "Maintenance Information Bulletin, MIB-125".



CALIBRATING TOOL FOR RADIO SETS AN/PRC-8,9,10

FIGURE - 5



ALIGNMENT TOOL

Figure 6

TONE MIXING ON UHF TELETYPE THROUGH CONTROL UNIT C-492/SG

Recently, several reports have been received regarding difficulty with the Model TDZ transmitter when used in conjunction with the AN/SGC-1 terminal equipment and type C-492/SG teletype-control unit.

The difficulty arises when the Send-Receive switch in the control unit C-492/SG is thrown to the Send position, thereby causing the MCW oscillator tone in the TDZ to mix with the tone output of the AN/SGC-1. This results in tones other than those desired being transmitted.

Under normal conditions where an M-15 teletypewriter is used for UHF communications, one of the following remedies will be found satisfactory.

(a) If the teletypewriter in question is used for UHF communications only, the Send-Receive switch and carrier-control contacts of the control unit C-492/SG should not be connected and the signal line should go directly from the printer to the teletype panel, leaving the only function of the control unit to turn the transmitter power on and off. It should be noted that the carrier-control feature of control unit C-492/SG is not required as this function is controlled automatically by the AN/SGC-1 terminal unit.

(b) In a second system, where the teletypewriter might also be used in HF receive only or HF send-receive circuits; the C-492/SG control unit should be wired in the normal manner, that is with the signal line and carrier control circuit fed through the control unit. When this condition exists, instead of throwing the Send-Receive switch to the Send position when it is desired to communicate on UHF, simply throw it to the Receive position and perform the necessary patching in the TT-23/SG teletype panel. This is possible since the printer and keyboard of a M-15 are connected in series.

Each of these systems, the conditions of which might be common in certain ships, has merit. However, it is believed that the latter method will be found more satisfactory in that it allows the teletypewriter to operate in other circuits also.

WIRING DIFFERENCES OF AN/SGC-1 AND AN/SGC-1A

Due to an internal wiring difference, chassis and cabinets of the AN/SGC-1 and the QN/SGC-1A radio-teletype terminal sets are not interchangeable. Subsequent to a field change, all installation and maintenance activities should not interchange chassis and cabinet of this equipment.

BAND PASS FILTER (SYMBOL NO. Z102) IN AN/SGC-1 AND AN/SGC-1A

Unsatisfactory performance has been reported in the above equipments due to defective Discriminator Z102. Instruction Books, NAVSHIPS 91152 and NAVSHIPS 91503 show the characteristics of the filter at 500 and 700 cycles to have zero attenuation. Indications are that certain capacitors used in the filter networks have increased in value sufficiently to lower the frequency of resonance.

ORIGINAL

When this condition exists, excessive attenuation to the incoming audio gain at the radio receiver is necessary. When the receiver gain is increased, noise may be introduced into the Radio-Teletype Terminal equipment that will cause reduced operating efficiency.

The Discriminator filter should be checked from time to time to insure that the resonant frequency is within plus or minus 5% or 500 and 700 cycles.

ADJUSTMENT OF SIGNAL INPUT LEVEL

Operators may have noticed that the Red-Receive panel light of Radio-Teletype Terminal Set, AN/SGC-1(), sometimes is illuminated even though no teletype signal is being received. The probable sources of this trouble are either interference, excessive ripple in the power supply of the AN/SGC-1() or its associated receiver, or a high noise level from the output of the associated radio receiver. The latter condition is the most probable cause of trouble and it is generally brought about through an improper setting of the squelch control on UHF receivers. The squelch level of the associated receiver and the Rec-level attenuator of the AN/SGC-1() should be adjusted to eliminate this trouble.

AN/SGC-1 ADJUSTMENT AND OPERATION

Two predominant causes for improper operation of Radio-Teletype Terminal Sets AN/SGC-1() are incorrect setting of the Mark Oscillator, Frequency-Adjust Control and excessive noise from the associated receiver. The Mark, Frequency-Adjust Control should be adjusted as indicated in the Instruction Book for AN/SGC-1 (NAVSHIPS 91152) and AN/SGC-1A (NAVSHIPS 91503). If an accurate test oscillator is not available, adjust the control to the midpoint of its physical rotation. The procedure outlined in NAVSHIPS 91503 should be disregarded as it may result in erroneous adjustment.

Spurious noise and static may lock the terminal in the receive condition which prevents the terminal from switching automatically to the send position. The squelch or silencer circuits of the associated receiver should be adjusted so that no audio-output is supplied from the receiver until the associated transmitting station goes on the air. Care must be taken to make sure that the adjustment of the squelch circuit does not lower or increase the sensitivity of the receiver excessively.

The following is the proper procedure for adjusting the squelch control:

- a. Rotate the squelch control to the least sensitive position of the receiver.
- b. With the transmitting station off the air, rotate the squelch control slowly toward the greatest sensitivity of the receiver until the Red-Receive lamp of the AN/SGC-1() is illuminated.
- c. Back off the squelch control slowly until the Red-Receive lamp is extinguished.

AN/SGC-1:1

AN/SGC-1() LOSSES IN FILTER Z102

Reports from using activities have stated that the insertion loss of filter Z102 in the AN/SGC-1() exceeds the values shown in figures 2-6 of NAVSHIPS 91152 and 91503. The electrical configuration of filter Z102 is shown in figure 1 of this article.

The actual insertion loss is greater than indicated in figure 2-6, since the graph is intended solely as an aid in understanding the theory of operation. The data on the graph should not be used to determine the performance of the filter.

The real and apparent losses through the filter, when measured with an electronic voltmeter such as the AN/USM-34, may total 10 to 12 db or more. The real loss through the filter is stated in the design specifications for the equipment. The design specifications read:

- a. The Mark filter shall present not more than 5-db attenuation at 700 cps. In addition, the attenuation curve shall be approximately symmetrical around 700 cps.
- b. The Space filter shall present not more than 5-db attenuation at 500 cps. In addition, the attenuation curve shall be approximately symmetrical around 500 cps. Test data on the 10-AN/SGC-1() equipments were taken by METU-5 and forwarded to the Bureau of Ships; test results are given in Tables I and II.

The test data indicate that the frequency of peak response on almost all filters has drifted downward. However, all filters have less than 5 db loss at the operating frequency except the mark filters for equipments 227 and 338.

In addition to the power consumed in the filter, another power loss of 7 db is incurred when the harmonics of the fundamental frequency are removed from the square wave output of V-102. When these losses are added, the total may be 10 to 12 db. This value corresponds closely to the

voltage drop across Z102, which is shown in figure 5-8 of NAVSHIPS 91152 and 91503.

The second requirement of filter Z102 is to attenuate the undesired frequency. Figure 2-6, of NAVSHIPS 91152, indicates the loss to be about 15 db. Paragraph 4 of section 2, NAVSHIPS 91152, states the attenuation to be about 18 db. The test data from METU-5 indicates the rejection of the mark sign by the space filter to be about 20 db and the rejection of the space sign by the mark filter to be about 11 db. It will be noted that the maximum attenuation of the space signal by the mark filter was obtained when the frequency of peak response of the mark filter was centered on 695 cps.

The limits for rejection were not defined in the original specification. Using activities have indicated that satisfactory operation may be obtained with 12 db attenuation.

To determine the performance of filter Z102, the test equipment should be connected as shown in figure 2. One vacuum tube voltmeter may be used for all tests. The test procedure follows:

1. Apply power to the AN/SGC-1() until the terminal equipment reaches normal operating temperatures. A minimum of 2 hours is usually required.
 2. Remove power from the AN/SGC-1() when making all test connections or adjustments. After the test connections or adjustments have been made, apply power. Observe all safety regulations.
 3. Remove V-101.
 4. Connect the audio oscillator to point A through an 0.1 - mfd dc blocking capacitor. Make sure that the audio oscillator is terminated in its correct impedance.
 5. Connect the V.T.V.M. to point B. Set the selector knobs on V.T.V.M. for the highest voltage on the ac range.
 6. Apply power to the AN/SGC-1(). Adjust the frequency of the audio oscillator for 500 cps, ± 5 cycles. Increase the output from the audio oscillator until the voltmeter at B ceases to rise in proportion to the input voltage. Note the voltage at B.
 7. Reduce the output of the audio oscillator until the voltage at point B decreases to 1/3 the value noted in step 6. This insures that the input to the filter is a sine wave and not a square wave. Under this operating condition, the measured attenuation is the real loss of the filter.
 8. Measure and record the voltages at points B, C and D.
 9. Adjust the frequency of the audio oscillator for 700 cps, ± 5 cycles. Adjust the output voltage until the voltmeter at point B reads the same as in step 6 above.
 10. Measure and record the voltages at points B, C, and D. The insertion loss of the mark filter is determined by dividing the voltage at point C in step 10 by the voltage at point B in step 10. The loss should not exceed 5 db. Table III shows db values for various voltage ratios.
- The insertion loss of the space filter is determined by dividing the voltage at point D in step 8 by the voltage at point B in step 8. The loss should not exceed 5 db.
- The rejection of the space frequency by the mark filter is found by dividing the voltage at point C in step 8 by

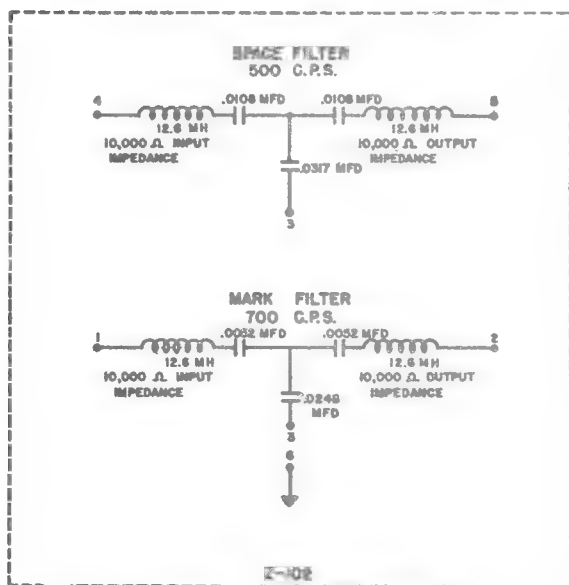


FIG. 1 ELECTRICAL CONFIGURATION OF FILTER

the voltage at point C in step 10. The loss should be 12 db or greater.

The rejection of the mark frequency by the space filter is found by dividing the voltage at point D in step 10 by the voltage at point D in step 8. The loss should be 12 db or greater.

11. Adjust the frequency of the audio oscillator from 400 to 800 cps in increments of 10 cps and repeat step 9 for each setting of the oscillator. Record the frequencies at which the voltage on points C and D are at a maximum.

If the insertion loss of the filter at the pass band exceeds 5 db or if the rejection of the undersired frequency is less than 12 db, the filter is defective and should be replaced.

If a replacement is not readily available, emergency repairs may be made on some filters where the frequency of peak response has shifted downward. The emergency

repairs are made by connecting external capacitors in series with the filter. The schematic diagram of the connections is shown in figure 3. The values of capacitors, which will give optimum performance, are best determined by trial and error. To select the range of values to be tried, Table IV may be used as a guide. The test procedure, to determine the performance of the filter should be repeated after each group of external capacitors have been connected into the circuit. If an improvements is noted, the capacitors may be bolted to the chassis and any splices covered with spaghetti. The physical dimensions of the capacitors, are shown in figure 4.

Any equipment modified by these emergency repairs should be tagged and identified so that it can be properly repaired at the earliest opportunity. The changes should be recorded on the Electronic-Equipment History Card, NAVSHIPS 536.

Table I
Electrical Characteristics of Space Filters in the AN/SGC-1

Equip Ser.	Freq of peak response in cps	Insertion loss in DB at peak response	Pass band Freq where Atten is 5 DB or less	Insertion loss in DB at mark Freq of 700 cps
227	485	2.8	385-525	25
229	420	2.3	385-525	24
230	420	3.8	385-505	25
231	435	2.5	400-535	23
232	505	3.0	395-535	24
233	425	2.4	390-530	24
236	400	3.6	375-500	26
238	420	3.9	390-515	25
363	430	2.5	395-530	25

Table II
Electrical Characteristics of Mark Filters in the AN/SGC-1

Equip Ser.	Freq of peak response in cps	Insertion loss in DB at peak response	Pass band Freq where Atten is 5 DB or less	Insertion loss in DB at mark Freq of 500 cps
227	650	3.4	590-680	14
229	640	3.7	620-710	18
230	665	3.8	600-700	15
231	695	3.8	615-725	18
232	610	4.5	590-700	15
233	620	4.0	590-700	15
236	600	3.5	570-695	17
238	635	4.0	600-705	15
363	675	3.8	600-705	17

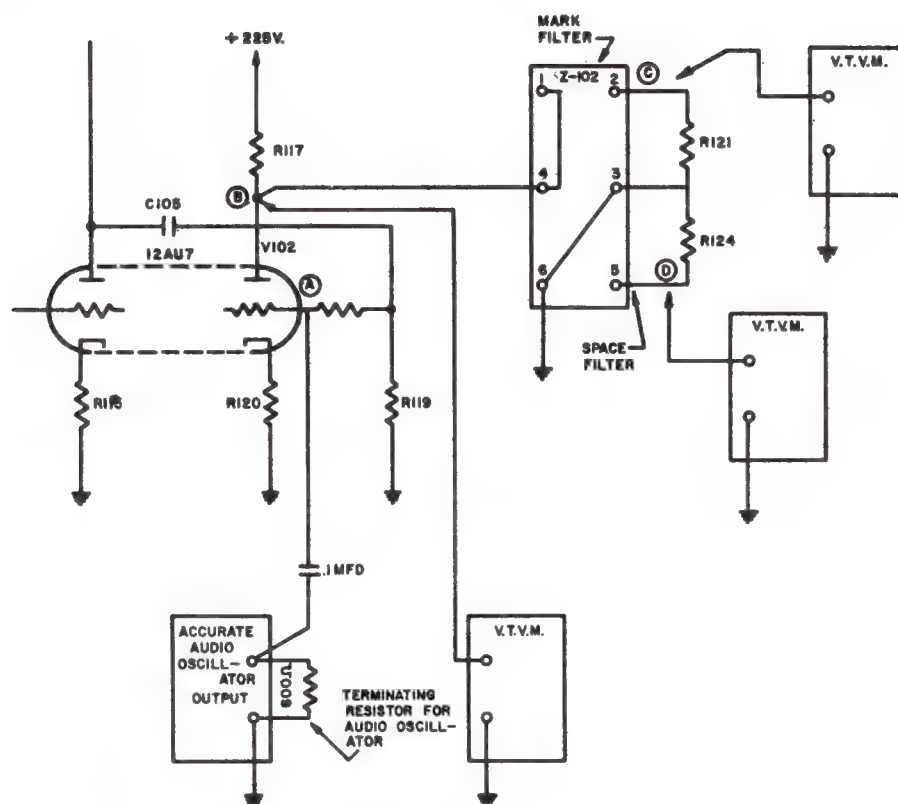


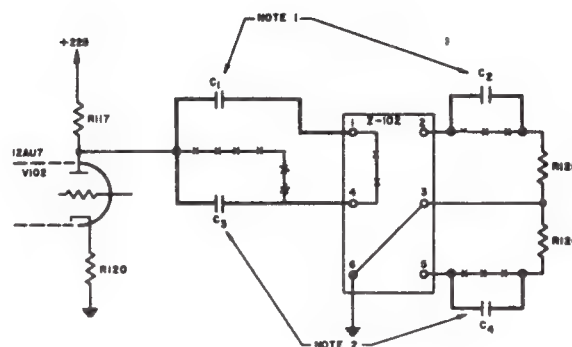
FIG. 2 CONNECTIONS FOR TEST EQUIPMENT

Table IV

Filter	Freq of peak response	Suggested values of external capacitors			
		C1	C2	C3	C4
Mark	550	.01	.01		
Mark	590	.01	.02		
Mark	630	.02	.02		
Mark	650	.02	.05		
Mark	665	.05	.05		
Mark	700	None	None		
Mark	725	No Corr.			
Mark	750	Possible			
Space	420			.02	.02
Space	450			.05	.05
Space	500			None	None
Space	525			No Corr.	
Space	550			Possible	

Table III

Voltage Ratio	Decibels
1.00	0
0.89	-1
0.79	-2
0.70	-3
0.62	-4
0.56	-5
0.50	-6
0.44	-7
0.39	-8
0.35	-9
0.31	-10
0.28	-11
0.25	-12
0.22	-13
0.20	-14
0.17	-15
0.16	-16
0.15	-17
0.12	-18



NOTES:
 1. ADD CAPACITORS C1 & C2 (SEE TABLE III) TO RAISE THE FREQUENCY OF THE MARK FILTER.
 2. ADD CAPACITORS C3 & C4 (SEE TABLE III) TO RAISE THE FREQUENCY OF THE SPACE FILTER.

FIG. 3 CONNECTION OF EXTERNAL CAPACITORS

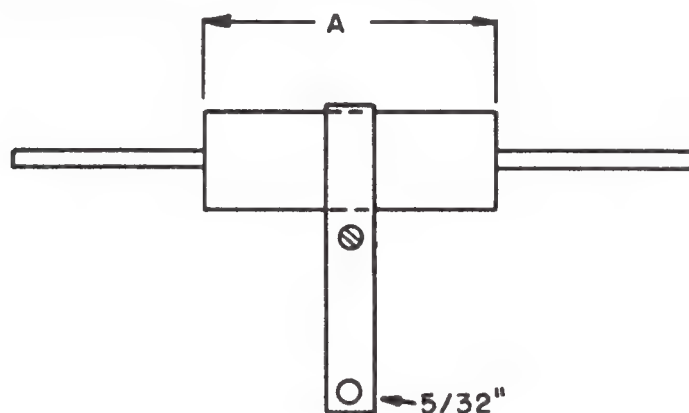


FIG. 4

PHYSICAL DIMENSIONS OF EXTERNAL CAPACITORS

CAPACITOR	DIMENSION "A"	DIMENSION "B"	CAPACITY
CP28AIEF 103K	1 5/16"	1/2"	.01 MFD
CP28AIEF 203K	1 13/16"	1/2"	.02 MFD
CP28AIEF 503K	1 11/16"	11/16"	.05 MFD

ORIGINAL

AN/SGC-1:5

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****AN/SIC-1 RADIO AND INTERCOMMUNICATION SYSTEM
ELIMINATION OF LOCK-OUT FEATURE**

The Bureau of Ships is presently preparing a field change bulletin for the AN/SIC-1 to eliminate the Lock-out feature on this equipment.

This field change has been initiated because operational procedures of aircraft-landing tactics have developed a change in CCA Radio-Communications Procedures.

Elimination of the "Lock-out" circuit may be accomplished in the OA-365/SIC-1 Communication Console by

connecting terminals 1149 through 1159 to ground on terminal 1187 of terminal board.

This information is supplied in advance of the field change bulletin due to the urgency in modifying the equipment at an early date to conform with revised operational procedures.

Ship-type Commanders may authorize this field change accomplishment upon the publication of the EIB notice.

**AN/SIC-1 RADIO AND INTERCOMMUNICATION SYSTEM
REPLACEMENT OF PANEL LAMPS**

Present indicator lamps, Sylvania Type 18A-2, 13212 to 13232 inclusive and 13244 and 13245 located in Console C-1064/SIG and 13501 to 13523 inclusive located in Sub-control LS-192 of Radio and Intercommunications System AN/SIC-1 lack sufficient brilliance and are not available through the Navy Supply System. An equivalent style bulb having increased brilliance is available in the Navy Supply System under Stock Number G17-L-6502. It is desirable that these lamps be substituted for existing lamps when required.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****ANTENNA GROUP AN/SRA-3**

Antenna Group AN/SRA-3 is presently being used as the antenna for Radio Set AN/VRC-8, -9, -10, -16, -17, and -18 where permanently installed aboard ship.

When used with these equipments, Antenna Coupler CU-226/SR, a component of the AN/SRA-3, is not required and should not be installed.

The coupler shall be turned over to the electronic's officer for disposal.

ORIGINAL**AN/SRA-3:1**

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****AN/SRA-9, -12 MODIFIED INSTALLATION METHOD**

It has been suggested that the method of mounting Electrical Filter Assemblies AN/SRA-9 and AN/SRA-12 be modified so that access to the rear of the unit can be gained for changing filter subassemblies without dismounting the whole unit. This can be accomplished by securing the right-hand end of the panel, by means of a piano hinge, to the standard 19-inch rack or other foundation. The left-hand end of the panel is secured by the usual No. 10-32 screws.

Normally, the proper filter subassemblies to cover the ship's regularly operating channels are installed at the shipyard and it is seldom necessary for ships force to change these subassemblies. For this reason, a general field change to modify the mounting of this equipment is not justified. The method indicated in the suggestion is satisfactory, but its use will be left to the discretion of the installing activity.

**ELECTRICAL FILTER ASSEMBLY AN/SRA-12, 12A,
EQUIPMENT AFFECTED**

Reception when using the AN/SRA-12 may be improved by proper internal connection and proper operation of the receivers connected to the filter assembly.

The following adjustments and connections should be checked:

a. Using AN/SRR-11, 12, or 13 receivers, the links in the antenna circuit should be connected for parallel operation and low impedance.

b. The antenna compensator controls on the front panel of all receivers should be rotated a full 360 in determining the position of maximum signal. In the AN/SRR-11 this rotation actuates a switch which adds a fixed capacitor over 180 of the rotation.

c. For maximum signal, only the red circled jacks at the bottom of each row should be used. The other jacks, which are connected to the filters through decoupling resistors, should be used only if more than one received frequency is within the pass band indicated above the row, or for very strong signals.

SERVICE NOTES**NAYSHIPS****900,000.1****COMMUNICATIONS****AN/SRA-13, -14, -15 ANTENNA COUPLERS FLEXIBLE
COUPLING CONNECTING L-2 TO P-1**

The silver-plated shim-stock flexible coupling, connecting the coil L-2 to P-1 in the coupler, has a tendency to break. Replacement of the flexible shim stock material is only temporary as repeated breakages occur resulting in operational delays until the repair can be made.

It is suggested that a short piece of flexible multi-strand copper wire, such as shield braid FSN G6145-191-8400, or equivalent, insulated with a piece of plastic tubing, replace each silver-plated flexible coupling.

Since changing to wire, no breaks have occurred and the operation of the coupler has not been hampered. The change can be made by ship's force. The time required to complete the change is approximately one hour per coupler group. No field change kit is necessary as the wire and insulating material can be obtained from stock.

ORIGINAL**AN/SRA-13:1**

ANTENNA TUNING GROUP AN/SRA-20 ROLLER MODIFICATION

The following information was submitted by Mobile Electronics Technical Unit Eleven:

"(a) When tuning channels 1 through 4, selector A allows four circuit to be operated from a single auto-transformer T-101, matching the antenna on four pre-set channels. The rollers, used to tune T-101 on channels 1 through 4, slide on fixed shafts and the clearance between roller and the shaft appears to be excessive. As a result, the rollers which do not make contact with the auto-transformer during the tuning of channels 1 through 4, will shift due to ship-board vibration and when a pre-set channel is again selected there is no assurance that it will remain tuned. A mismatch can result. Operation of Control B also resulted in unused roller movement.

(b) S-101C Channel selector C acted much as did Channel selector A. This problem was more pronounced in positions 1 and 2 which affected L-101 and L-102 and was more

critical than the situation described above. The rollers may be stabilized on the stationary shafts by the addition of a spring loaded contact as illustrated in Figure 1."

It is recommended that ships experiencing difficulty with the AN/SRA-20 coil rollers in the R F tuner unit, modify these rollers as described.

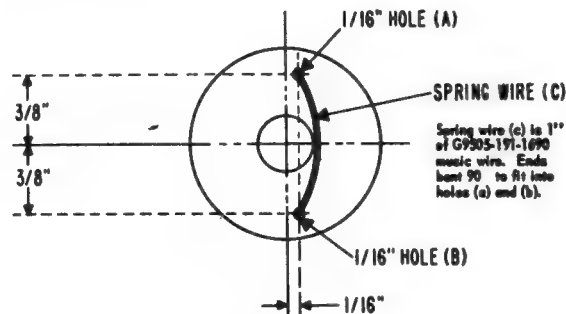


FIGURE 1

Antenna Coupler Group AN/SRA-22

Recent Performance and Operational Reports indicate several equipment failures that have been attributed to improper operation or installations.

It is important to tune the AN/SRA-22 with only TUNE power applied from the associated Radio Set AN/URC-32 (tune switch is located on the power amplifier chassis), otherwise a badly detuned antenna can cause damage to the coupler unit if full power is applied. Additionally, the AN/SRA-22 antenna coupler control unit contains a SERIES-SHUNT and CAPACITOR switch that must be operated in accordance with the instructions in the technical manual (or on the associated Operating Instructions Chart). Steps should be followed in that definite discreet sequence and this switch should not be moved again until the red light on the panel indicates the variable capacitor of the coupler has stopped moving as indicated by the red light being extinguished.

On certain frequencies and when working into a whip antenna, if the switch is moved more than one step at a time, a radical large change in Ω is possible so that exceptionally high voltages can develop within the coupler to cause a voltage breakdown.

Additional difficulties reported indicate that improper antenna tuning is caused by a dirty antenna base insulator, leaky coaxial cable transmission line to the coupler, or inadequate coupler unit grounding. Periodic inspection and cleaning of the antenna base insulator "megger" checks of the transmission line, and verification of a good ground connection to the Coupler CU-714/SRA-22 case will reduce these failures. Do not rely on a good ground being provided by the bolts attaching the coupler to its mounting; a separate ground strap is mandatory.

AN/SRA-22 ANTENNA COUPLER-BUREAU OF SHIPS PLAN DISCREPANCY

BUSHIPS plan RE47C2013, recently issued, contained an inadvertent wiring error. Installations of Antenna Coupler AN/SRA-22, using this drawing for cabling information, has resulted in a damaged tuner unit.

BUSHIPS plan RE47C2013 has been superseded by plan RE47D2021A. This plan and the AN/SRA-22 Technical Manual (NAVSHIPS 93286) are correct and shall be used.

AN/SRA-22-TUNING INFORMATION

In order to assure proper tuning of the AN/SRA-22 equipment and to eliminate equipment failure, the following points should be understood:

1. Do not operate the AN/URC-32 at output powers of over 500 watts.
2. Always use "Tune" power of the AN/URC-32 when tuning the AN/SRA-22.
3. When tuning the AN/SRA-22 to any new or change of frequency, always start the tuning procedure with:
 - a. Capacitor series/shunt switch on "Shunt"
 - b. Capacitor switch on "Position 1"
 - c. Coil and tap dials on "100"
 - d. Coil and tap meter on "0"
 - e. Capacitor-indicator light (red) "Out"
4. Do not rely on fixed precalibrated capacitor, coil, or tap settings issued by any activity unless these settings have proven to be satisfactory by actually checking the settings, by tuning the AN/SRA-22 in accordance with the existing procedures in NAVSHIPS 93286 change 2, or NAVSHIPS 93286.21(A). (Note: These publications are now available in Navy issuing activities and they should be requisitioned as soon as possible.) The impedances of 35-foot whip antennas on board ships are not necessarily the same because impedance depends on many factors; thus the AN/SRA-22 settings of capacitor, coil, and tap will not be the same for all ships or even for the same class of ships. It is best to calibrate each antenna and AN/SRA-22 using the information (Procedures) in the above mentioned publications and not to take for granted the AN/SRA-22 settings that were taken on other ships.

AN/SRA-22-INSTALLATION

In cases where installation requirements dictate the need for a right-angle multiconductor plug, in lieu of the supplied straight type (P5), the following plug may be requisitioned and installed:

	Type	FSN
Connector	AN3106A-34-285(c)	N5935-522-2668
Clamp	AN3057-16	N5935-283-3402

The connector sleeve supplied with the equipments plug (P5) may be removed and used on the right-angle type connector.

SERVICE NOTES

NAVSHIPS

900,000.1

COMMUNICATIONS

OPERATION OF ANTENNA COUPLER AN/SRA-23(XN-1) WITH THE AN/URT-17 TRANSMITTER

Antenna coupler AN/SRA-23(XN-1) is capable of handling the output of transmitter AN/URT-17 without damage. It is necessary, however, to recalibrate the INCIDENT POWER meter in the coupler for full scale deflection with 1000 watts of RF power instead of 500 watts for which the meter was originally calibrated. To accomplish this, proceed as follows:

1. Connect a dummy load, DA-91/UR or equivalent, to the antenna terminal of the antenna coupler. (**WARNING:** This dummy load is rated at 500 watts without forced-air cooling. When dissipating 1000 watts, apply power only intermittently, 15-seconds on and 45-seconds off.)

2. Adjust the transmitter for a low-output indication on coupler incident-power-meter (about 250 watts). Complete

tuning of transmitter and coupler for normal operation. Adjust incident-power-meter calibrating potentiometer for down-scale reading, to potentiometer stop.

3. Adjust transmitter CW carrier to give 4.5-amperes of output current into the coupler, giving approximately 1000 watts into a 50-ohm load.

4. Adjust the incident-power-meter calibrating potentiometer so that meter reads 500 watts. Do not touch the reflected-power-meter calibrating potentiometer.

5. Attach a label to the incident-power-meter face indicating "METER READING X2." This completes the recalibrating procedure.

The above procedure is applicable to other installations involving transmitters with 1000-watt output capability when used with antenna couplers AN/SRA-23 (XN-1).

**AN/SRC-10(), -11(), -12(), -13(), -14(), -15()
REMOVAL OF AUDIO RECEPTACLE WATERPROOF
CAPS**

In a recent Bureau of Ships Inspection of completed installations, it was noted that waterproof caps for the AUDIO receptacles were installed on many of the Receiver-Transmitters and Auxiliary Receivers. At the discretion of the Electronics Officer, these caps may be removed from these equipments and used to accomplish Field Change 1-AN/URC-16(), -17(), -18(). (See EIB 415, dated 12 September 1955, for the complete field change.) These caps were provided to prevent water accumulation in the receptacle when the equipment is exposed to the weather. Since the AN/SRC-() equipment is normally installed in weather-protected spaces, these caps are not required.

**AN/SRC-10() THRU -15() AN/SRC-16() THRU -18()
MISLEADING RF OUTPUT INDICATIONS**

When the front panel meter switch in Receiver-Transmitter RT-66/GRC, RT-67/GRC and RT-68/GRC is in the RF position, a high reading will result when no antenna or a poor antenna is used (possibly due to broken or damaged co-ax feeder). This indication is misleading, since operators may interpret it to mean superior performance, when actual performance is unsatisfactory.

The circuitry is such that the meter indication is proportional to voltage induced across the inductance of a tuned circuit. This voltage will be high when the output circuit is unloaded and will be relatively low when the

output circuit is loaded into an antenna. If an unloaded condition, such as that described, is allowed to persist, the germanium crystal in the meter circuit may be damaged.

Include the following warning note in the Technical Manual for the Receiver-Transmitters (TM11-289):

WARNING

DO NOT OPERATE EQUIPMENT WITHOUT
AN ANTENNA OR DUMMY ANTENNA
LOAD CONNECTED TO THE "ANT"
CONNECTOR WITH THE METER SELEC-
TOR SWITCH IN THE "RF" POSITION.

The Signal Corps Engineering Laboratory is investigating a new design of the antenna circuit which will prevent germanium crystal burn-out under no load conditions. Based on excerpts from Signal Corps Maintenance Symposium Report date 1 April 1955.

**AN/SRC-10, -10X, -11, -11X, -12, -12X, -13, -13X,
-14, -14X, -15, -15X INSTALLATION IMPROVEMENT**

The Assistant Industrial Manager, USN, San Francisco has forwarded a recommendation to provide an 8-inch x 10-inch access hole in the foundations for Radio Sets AN/SRC-10, -10X, -11, -11X, -12, -12X, -13, -13X, -14, -14X, -15, -15X. This hole will provide access to the terminal box, located on mounting MT-299/GR or MT-327/GR, which contains the supply line fuse.

R-623/SRD-7 DIRECTION FINDER RECEIVER MODIFICATION TO PIVOT PLATE AND SUPPORT LUG OF UPPER DRAWER

To prevent the upper drawer of R-623/SRD17 from slipping from its pivot plate when the drawer is extended, the following modification is recommended. Drill, tap, and counter sink support lug as shown in figure 1. Assemble unit as shown in figure 2.

Even with this modification installed, excessive weight should not be put on the upper drawer of R-623/SRD-7.

AN/SRD-7 Submarine Installations: Performance and Operational Report

The Bureau has received verbal reports of failure of AN/SRD-7 equipment aboard submarines. Additional information regarding equipment deficiencies is required to make a thorough study.

Performance and operational reports, NAVSHIPS 3878, shall be submitted for all AN/SRD-7 submarine installations.

It is requested that special installation problems of antenna and cable leakage be included under "remarks."

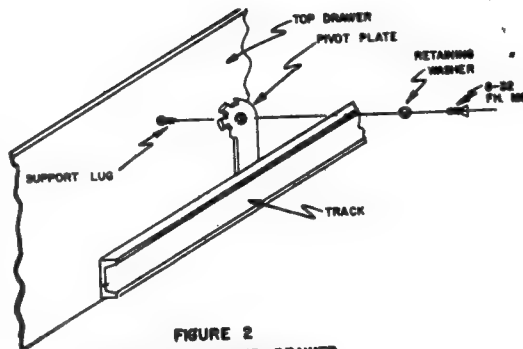


FIGURE 2
VIEW OF MODIFIED DRAWER
ASSEMBLY (R. H. SIDE)

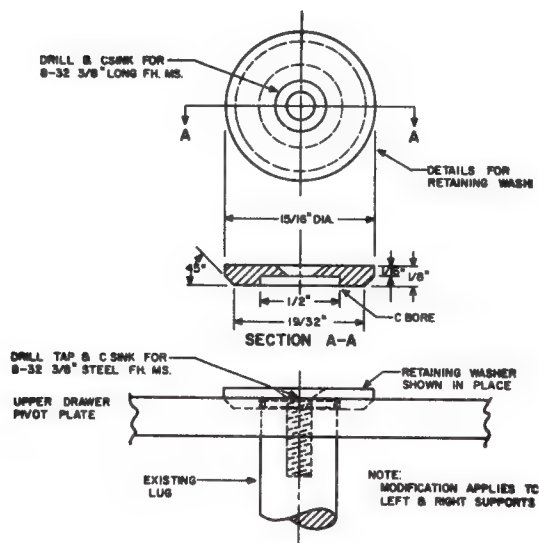


FIGURE 1
MODIFICATION TO PIVOT PLATE & LUG OF
UPPER DRAWER OF AN/SRD-7 RECEIVER

TESTING AN/SRR-4 ANTENNAS

The following methods for checking Model AN/SRR-4 "AEW" antennas are recommended for use.

The normal method of testing Model AN/SRR-4 equipment without an equipped plane is to feed rf from the 50-ohm output of the SG-31/U signal generator into the antenna jack of the receiver. This method checks all system components except the antenna and transmission line.

To accomplish a complete system check including antennas, the rf output from the SG-31/U was fed into an omnidirectional antenna type AS-466/SRR which was located approximately 200 yards away from the ship under test. The equipment aboard ship responded satisfactorily to the transmitted signal from the SG-31/U, however, no attempt was made by Charleston Naval Shipyard to determine signal output necessary to cause the system to track.

Another test which is similar to the one above and which can be used in diversity installations is to feed the RF signal out on one antenna and receive on the other.

AN/SRR-4, -4A ELIMINATION OF FAILURE OF ROTARY SWITCH SA-215/U

The SA-215/U rotary switch should be removed and the RG-18/U antenna cables terminated with UG-334/U coax

connectors located on a mounting plate near the R-360/SRR-4 Radio Receiver. The UG-21B/U connectors on the antenna end of the RG-10/U receiver cables must be replaced by UG-59A/U coax connectors. Either receiver may be connected to either antenna by manually interchanging cables.

MOUNTING OF AN/SRR-11, -12, -13

The following beneficial suggestion points out that when AN/SRR-11, AN/SRR-12 and AN/SRR-13 equipments are SRR-11, AN/SRR-12 and AN/SRR-13 equipments are mounted with the edge of the front panel flush with the edge of the table or shelf, the chassis may be damaged when it is pulled out for inspection or repair.

This damage can be prevented by mounting the receivers so that the front panel will overhang the shelf or table edge by approximately 1 inch. If, in certain installations, this is not possible, the equipment should be raised approximately 1½ inches above the mounting surface. This is done by installing a spacer bar which extends the width of the cabinet (using the receiver mounting holes) to give solid support and adequate clearance.

AN/SRR AND AN/FRR EQUIPMENT SERIES SWITCH ARM COUPLING ASSEMBLIES

For the purpose of standardization and simplification of equipment support, only two of the subject switch Arm-Coupling Assemblies will be utilized in the future for all applications within the subject equipments. The two assemblies now used are of improved design which should eliminate the excessive breakage experienced in the past. The following table of application to the subject equipments applies. Maintenance Support will be obtained by requisitioning the item required by FSN indicated in table 1. connection to a local jackbox, NT-49049 or similar. The PHONES LEVEL control on the front panel of the receiver controls the audio level at this jackbox without affecting the audio level on the AUDIO LINE receptacle. The

TABLE 1 Location of Switch Arm Coupling Assemblies

<i>Ref. Symbol</i>	<i>Associated Switch Symbol</i>	<i>Equipments affected</i>	<i>RCA Part Number</i>	<i>Federal Stock Number</i>
O-103	S-101	AN/SRR-11, AN/FRR-21	A-8834099-502	N5930-606-5287
O-126	S-126	" "	" "	" "
O-151	S-151	" "	" "	" "
O-201	S-201	" "	" "	" "
O-304	S-301	AN/SRR-12	" "	" "
	and			
	S-302	" "	" "	" "
O-327	S-326	AN/SRR-12	" "	" "
O-352	S-351	AN/SRR-12, AN/FRR-22	" "	" "
O-402	S-401	" "	" "	" "
O-504	S-501	AN/SRR-13, 13A	" "	" "
	and			
	S-502	" "	" "	" "
O-527	S-526	" "	" "	" "
O-552	S-551	AN/SRR-13, 13A, AN/FRR-23	" "	" "
O-602	S-601	AN/SRR-13, 13A	" "	" "
O-701	S-701	AN/SRR-11, AN/FRR-21	" "	" "
O-801	S-801	AN/SRR-12, 13, 13A, AN/FRR-22	" "	" "
O-1007	S-1001	AN/SRR-11, 12, 13, 13A	A-8816321-501	N5930-320-8275
	and	AN/FRR-21, 22, 23		
	S-1002	" "	" "	" "
O-1008	S-1003	" "	" "	" "
O-1301	S-1301	" "	" "	" "
O-3002	S-3001	AN/FRR-22	A-8834099-502	N5930-606-5287
O-3036	S-3035	" "	" "	" "
	and			
	S-3036	" "	" "	" "
O-3102	S-3101	AN/FRR-23	" "	" "
O-3136	S-3135	AN/FRR-23	" "	" "
	and			
	S-3136	" "	" "	" "
O-4402	S-4401	" "	" "	" "
	S-1101	AN/SRR-11, 12, 13, 13A, AN/FRR-21, 22, 23	A-8816321-501	N5930-320-8275

COMMUNICATIONS**NAVSHIPS****900,000.1****SERVICE NOTES**

receptacle marked AUDIO LINE is for connection to the remote control switchboard SB-82/SRR or similar. The audio line level at the remote control switchboard is controlled by the OUTPUT and GAIN controls. This level is controlled at the remote speaker-amplifier as desired.

MECHANICAL PARTS STOCKED FOR AN/SRR 11-13A

Due to fleet reports of failure of mechanical parts for AN/SRR-11, 12, 13, and 13A Radio-Receiver Equipments, ESO has numbered and stocked the following parts:

Symbol	Name	FSN
0-103	Arm	N5820-346-9133
0-261	Handle	N5340-303-3865
0-1007	Arm	N5930-320-8275

Normally these items are not subject to failure and will not be included in ERPAL's. Requisitions for these items should be forwarded through normal supply channels.

Radio Receiving Sets AN/SRR-11, -12, and -13A

The Bureau has received indications that some activities are discarding sub-units of AN/SRR-11, -12, and -13A when they are replaced with a new subunit due to failure of a capacitor, resistor, or electron tube. These subunits are repairable by ships' forces and should not be discarded. Do not throw away expensive assemblies when they can be returned to service by replacement of an inexpensive part or tube.

AN/SRR-13 IMPROVEMENT OF PERFORMANCE

The Ballast Tube, R1605, in the AN/SRR-13 has been reported as failing constantly.

The ET on the USS REAPER, MSO-467, has apparently found a way to extend the life of this ballast tube since, over a ten-month period, he has had no failures. How did he do this? Simply by switching the receiver to STANDBY condition when not in use, instead of securing the equipment completely. This ET has passed word to the ET's on other ships in his division. As a result of adoption of this suggestion, the ET's on these ships have found that the life of R-1605 has been increased considerably. It was found also that reliability of the AN/SRR-13 receiver was increased.

It is recommended that ships, having these receivers installed, place them in STANDBY instead of securing them when not in use. Better reliability will result.

Congratulations to the ET on the USS REAPER MSO-467 for his initiative in bringing these facts to the attention of his shipmates.

AN/SRR-13A RADIO-RECEIVERS, AUDIO-OUTPUT CONNECTIONS

The audio output receptacles on the rear panel of the AN/SRR-13A receivers differ from those provided on the AN/SRR-13. The AN/SRR-13 receptacles were connected in parallel, whereas the AN/SRR-13A provide independent audio output. The receptacle marked AUDIO PHONE is for connections to a local jackbox, NT-49049. The PHONE LEVER control on the front panel of the receiver controls the audio level at this jackbox without affecting the AUDIO LINE receptacle. The receptacle marked AUDIO LINE is for connection to the remote control switchboard SB-82/SRR. The audio line level at the remote control switchboard is controlled by the OUTPUT and GAIN Controls. This level is controlled at the remote speaker-amplifier as desired.

SERVICE NOTES**NAVSHIPS 900,000.1****COMMUNICATIONS****AN/SRT, AN/URT TUNERS NITROGEN PIPING**

A suggested method to eliminate the problem of thread damage and loss of nitrogen from the tuner due to the softness of the aluminum end plate when the 1/8-inch IPS Schraeder valve is removed has been received.

It is suggested that a 3/8-inch by 1/8-inch IPS Monel bushing be used in place of the 1/8-inch IPS Schraeder valve, eliminating thread damage and effecting a good tight joint.

ORIGINAL**AN/SRT:1**

CONNECTIONS OF AN/SRT-14, -15, -16 RADIO TRANSMITTING SETS

A report was recently received from Philadelphia Naval Shipyard concerning an experience with the AN/SRT-16 Radio Transmitters installed on the USS WILLIS (DE-1027) and USS VOORHIS (DE-1028).

The shipyard's experience indicated that during installation and connection of the separate units of the transmitter, proper phasing of wires on terminals 19 and 20 of TB E602 was not accomplished by the installing activity. The net result of improper phasing will cause costly damage to K3004 relay. The same action will occur if 110v is fed externally from a separate source and proper phasing is not effected between the 100-watt portion and the 500-watt portion of the AN/SRT-16 transmitter.

AN/SRT-14, -15 AND -16 WIRING ERROR

The following wiring errors have been noted in some of the Low-Voltage Power Supplies PP-1094/SRT, manufactured by Federal Telephone and Radio Company:

1. Relay K-3004-4L was wired to terminal 1 of fuse F-3009, instead of terminal 2 of F-3009.
2. Transformer T-3001 terminal 1 was wired to terminal 2 of fuse F-3009, instead of terminal 1 of F-3009, Figure 1.

The correct wiring, (Figure 2), is shown in the schematic diagram, figure 7-50 of Instruction Book NavShips 92121, for AN/SRT-14, -15, and -16.

To correct this wiring error, remove lead between relay K-3004-4L and fuse F-3009 terminal 1 from F-3009 terminal 1 and connect it to F-3009 terminal 2. Remove lead between transformer T-3001 terminal 1 and fuse F-3009 terminal 2, from F-3009 terminal 2 and connect it to F-3009 terminal 1.

AN/SRT-14, -15, -16 METHODS FOR CHECKING PERCENT MODULATION

The Preliminary Instruction Book for Radio Transmitting Sets AN/SRT-14, -15 and -16 (NAVSHIPS 92121) does not include a satisfactory method for checking the percentage of modulation. Therefore, two methods are presented herein. The first will enable the technician to make a rapid check during routine testing and the second is a precise method for checking and adjusting the transmitter for 100-percent modulation.

A rapid check of percent modulation can be made as follows using the Antenna Current Meter on the front panel of the r-f Amplifier:

1. Tune the transmitter to the desired frequency at the 100-watt level.
2. Set the Service Selective Switch (U) to the phone position and the Microphone Switch (Y) to the proper position in accordance with type of microphone used.
3. Place the Local-Remote Switch (X) in Local and the Stand-by-Operate Switch (PP) in operate position.

4. Connect a handset in the Handset Receptacle.
5. Depress the Push-to-Talk Switch on the handset. Talk or whistle into the microphone and observe the Antenna Current Meter. With an increase in modulation, the meter will show an increase in current. When this meter shows a decrease in Antenna Current after an increase in modulation, over-modulation is generally indicated.

When this occurs, the following, more precise, method should be used in checking and setting the transmitter for 100-percent modulation:

1. Turn transmitter to desired frequency at the 100-watt level.
2. Turn transmitter power off.
3. Pull out the r-f amplifier drawer.
4. Couple the r-f output of the Transmitter (either one of the two terminals on the rear of the Antenna Current Meter) to the vertical deflection plate of the OS-8/U Oscilloscope (or equivalent).

NOTE:

A minimum amount of r-f coupling is desirable. This may be accomplished by connecting wires to both the Antenna Current Meter and to the vertical input of the oscilloscope and coupling these wires without making any direct connection between them. Capacitive coupling between these wires should be varied to the required degree to provide (as nearly as possible) a trapezoidal pattern without phase shift. The typical percent modulation patterns of Figure 1 show a trapezoidal pattern with phase shift present. Figure 2 represents an ideal trapezoidal pattern.

5. Connect the horizontal amplifier input of the oscilloscope to the modulation-output jack, J-1309, provided for test purposes on the right side of the r-f amplifier drawer.

6. Short circuit the interlock on the r-f amplifier drawer.

7. Set the Service Selector Switch (U) to the phone position and Microphone Switch (Y) to the proper position.

8. Place the Local-Remote Switch (X) in Local, and the Stand-by Operate Switch (PP) in operate position. Then, turn transmitter power on.

9. Connect a handset in the Handset receptacle. Set the Gain to Clip Control (M) to ensure proper clippings.

10. Depress the Press-to-Talk Switch on the handset and talk into the phone, observing the pattern obtained, and compare with patterns shown in Figure 1.

11. Referring to Figure 1, adjust the percent Modulation Control (N) for 100-percent modulation at audio peaks.

It is recommended that technical personnel place this article in the preliminary instruction book for ready reference until such time as the final instruction book for these equipments is available.

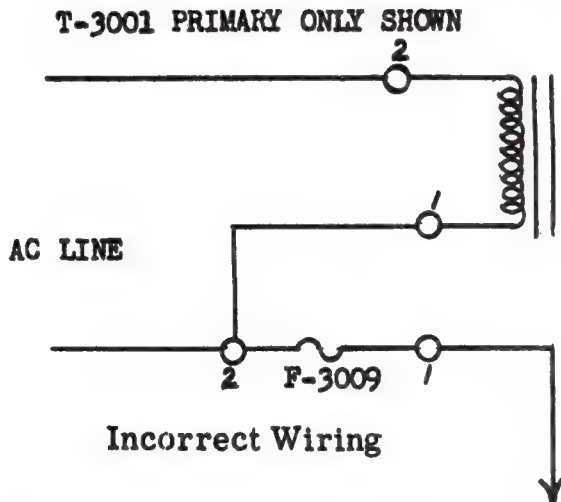


FIGURE 1 TO K-3004-4L
BASE BLOWERS

The correct wiring, as shown in the schematic diagram, figure 7-50 of Instruction Book NavShips 92121, for AN/SRT-14, -15 and -16 is shown below.

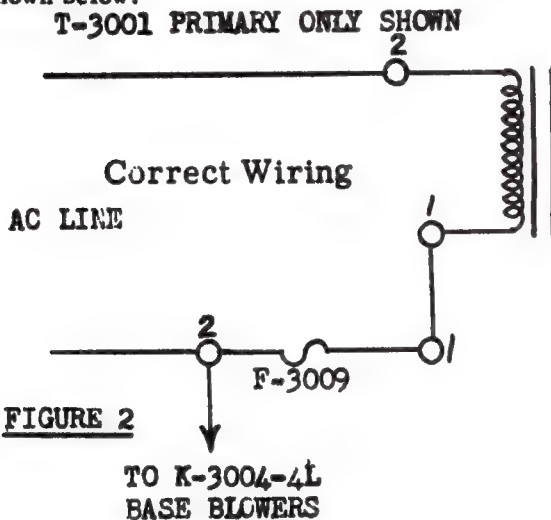


FIGURE 2

**MODEL AN/SRT-14, -14A, -15, -15A, -16, -16A RADIO
TRANSMITTERS; PREVENTION OF MALFUNCTION OF
ANTENNA SWITCHING RELAY, K-1306 AND KEYING
RELAY K-1101**

The many failures of antenna changeover relay K-1306 and keying relay K-1101 in the AN/SRT-14, -15 and -16 series radio transmitter, have prompted a study of this problem by the Bureau of Ships.

The operation of the above relays is such that malfunctioning of one reflects in the operation of the other. In hand-key operation, for example, the antenna-transfer relay K-1306 must "make" before -24VDC is available for energizing K-1101 (keying relay) solenoid. The closing of

AN/SRT-14:2

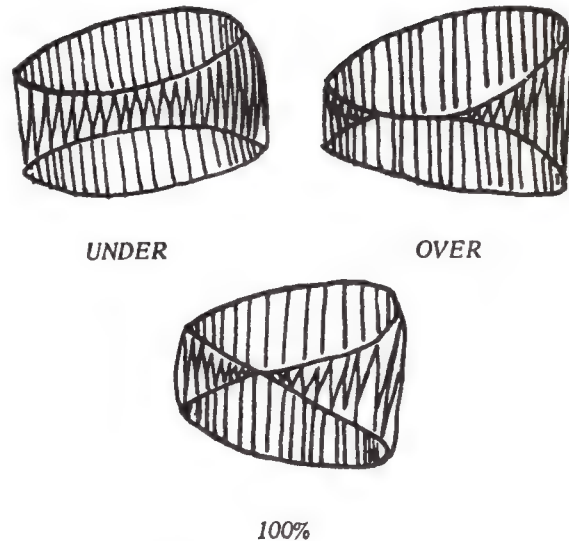


Fig. 1 Typical percent Modulation Patterns

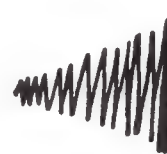


Fig. 2 Trapezoidal Pattern

K-1101, in turn, holds K-1306 in until the contacts of K-1101 are opened by unkeying the transmitter. If the above sequence of operation is proper, arcing of K-1306 contacts, due to the presence of rf. is prevented.

It is believed that the above sequence of operations causes unnecessary fatigue in the antenna switching relay, especially in the hand-key mode of operation, since this relay (K-1306) is following keying relay, K-1101.

One solution to this problem would be the incorporation of a time-delay circuit, which would "hold-in" the antenna switching relay during normal keying rates, thus reducing the relay's work load by as much as 90%.

A variable time delay (.5 to 6 secs.) is used in the AN/SRT-14, -15, -16 series transmitters to control the operation of the Antenna Tuning Group. This allows the Antenna Tuning Unit to "hold-in" during keying but permitting straight-thru operation during key-up time. This permits a receiver to be tuned to a different frequency from that of the transmitter while utilizing the same antenna.

This modification utilizes the above time-delay unit to perform the additional function of operating the antenna-switching relay as well as the Antenna Tuning Unit. In this method of operation, K-1306 must first close before the keying Relay K-1101 will operate, but opens only after a preset time delay. This modification has been accom-

ORIGINAL

published on AN/SRT-16 Transmitter Serial 931. Subsequent testing indicated satisfactory operation. Modification is as follows:

I Modification of Radio Modulator MD-229/SRT (LLRM).

1. Remove the LLRM drawer from cabinet and place on bench. Removed four mounting screws and lift up the terminal assembly (located in the top rear of unit), which contains J-1101, J-1102 and J-1103, to gain access to wiring terminals on underside.

2. Disconnect the lead from terminal No. 13 of J-1102, tape the exposed wire and lay aside. (Refer to Figure 7-58, 7-114 and 7-153 of Technical Manual NAVSHIPS 92121(A).

3. Connect jumper wire from terminal No. 10 of J-1103 to terminal No. 13 of J-1102.

4. Disconnect the lead from terminal No. 9 of J-1103; connect this lead to terminal No. 5 of J-1101. Leave existing lead connected on terminal No. 5.

II Modification of Radio Frequency Amplifier AM-110R/SRT (RFA).

1. Disconnect the two leads from antenna-switching relay (K-1306) solenoid terminal No. 2C (Refer to Figure 7-114 of Technical Manual NAVSHIPS 92121(A).

2. One of these leads is a jumper between terminal No. 2C of solenoid and relay contact No. 6R. Disconnect jumper and lay aside.

3. Connect the remaining lead, which was removed from terminal No. 2C of solenoid, to contact No. 6R of relay stack.

4. Using the jumper removed in Step 2, connect relay - solenoid terminal No. 2C to ground via ground lug found immediately under the relay.

The time-delay circuit located in the LLRM (MD-229/SRT), which is used to control the operation of the Antenna Tuning Unit, is of the Vacuum-Tube Type. It consists of V-1023A limiter and V-1023B transfer-control tube which operates K-1102. The input of the time-delay circuit is tied directly across the keying line. As a result, any spurious voltage, hum, dc transients, etc., may trigger the time-delay circuit. This, in turn, would cause erratic operation of the Antenna - Tuning Unit and, in the case of the preceding modification, also cause the antenna switching relay, K-1306, to operate sporadically without any keying signal present on the keying line.

As an example of the above, in the transmitter in which the preceding modification was installed, a 60-cycle voltage appearing on the keying line when the LOCAL-REMOTE (S-1106) switch was in REMOTE position caused erratic operation or triggering of the time-delay circuit, which in turn, operated the antenna-switching relay. This voltage was traced to leakage across the REMOTE-LOCAL switch contacts. Rotation of the switch had caused metal to be deposited on the ceramic wafer creating a resistance of approximately 20k between the contacts carrying the remote-keying line and the contacts connected to the remote START-STOP function of the transmitter. These latter contacts carry 110VAC.

Any malfunctioning of the Time-Delay circuit, such as that previously mentioned, can be identified by the use of

an oscilloscope placed across the keying line while it is unkeyed.

This modification will be published as a field change in the near future.

AN/SRT-14, -15, -16 VERSUS AN/SRT-14A, -15A, -16A

Information from field activities indicate that some ambiguity exists in connection with the difference between the radio transmitters AN/SRT-14, -15, -16 and AN/SRT-14A, -15A, -16A.

The only difference is that the models AN/SRT-14A, -15A, and 16A are manufactured of nonmagnetic material. The A models are not improved versions.

AN/SRT-14, -15, -16 AN/SRA-18 REPAIR OF MAGNETIC ACTUATOR COILS

The following procedure for repairing the magnetic actuator coils in lieu of replacing the complete actuator, was submitted to the Bureau PROCEDURE:

1. Carefully remove the magnetic actuator from the Tuner or Coupler. (Refer to the Technical Manual for Radio Transmitting Set AN/SRT-14, -15, -16, NAVSHIPS 92121(A)).

2. Remove the spring-driven shaft by tapping it gently from the bushings, after removing the retainer ring. Keep all parts, as they will be used again. Slide actuating spring out of the solenoid armature, and lift out armature.

3. Carefully pry up rolled edge of tubular armature guide, and drive guide out through bottom of actuator casting. This will release burned out coil.

4. Remove and discard the burned-out coil winding. A knife facilitates this operation. Using the same coil form, and #26 AWG double-enamelled magnetic wire, rewind the coil. Approximately 990 turns, or until the dc resistance equals 15 ohms. Experiment has shown that if this resistance is exceeded, the magnetorotor operates too slowly, causing it to overheat.

5. To the ends of the coil winding, solder pig-tail leads similar to the original. Wrap coil winding with cotton tape and seal with Glyptol or other electrical varnish.

6. Replace coil form in magnetorotor casting, and reinsert tubular armature guide. Roll edge over to lock in place. Slide armature into position, making sure that it moves freely. Place actuator spring through hole in armature and spring guide and re-install driven shaft and retainer.

7. Replace magnetic actuator into equipment. Follow instructions in NAVSHIPS 92121(A) for installation of new actuator.

This procedure not only saves the cost of a new unit, but eliminates the necessity of drilling an accurately placed hole in the shaft of the new unit.

AN/SRT-14, -15, -16—Adjusting Frequency Converter, Unit 9

The following suggestion should be helpful to all activities concerned with maintenance of the AN/SRT-14, -15, -16 series transmitters:

In order to properly adjust Unit 9, the position of knob HH should correspond to the position of switch S-2427, for each of the adjustments listed in both sections of table 7-20, page, 46, of NAVSHIPS 92121(A) and NAVSHIPS 92121.3. It is suggested that step 7 be modified to include knob HH in the same position as switch S-2427. Table 7-20, upper-left block, should read as follows: "Position of knob HH and Pointer on S-2427.

AN/SRT-14, -15, -16 QUICK CHECKING TUNING DIFFICULTIES ON RADIO TRANSMITTING SETS

The following maintenance information is applicable to transmitters AN/SRT-14, -15, and 16.

1. When tuning difficulties of a permanent nature occur with the AN/SRT-14, -15, and -16 series transmitters, breakdowns will be attributed to the antenna coupler and tuner, or to the transmitter coupler. Since the transmitter coupler, CU-402/SRT, is more suitable located for accessibility as well as weatherwise, a system of quick checking

this unit was devised which may be of interest to those concerned.

2. A dummy load on the CU-402/SRT will check its operation below a 2:1 Standing Wave Ratio (SWR) only. To check its operation for other values of SWR, a quarter wavelength of RG-8/U cable was used terminated with 208 ohms of resistance so as to give an SWR of 4:1 on a 52-ohm transmission line.

3. The line should be a quarter wavelength so that the standing wave is capable of manifesting itself; any longer length than this is unnecessary as line losses begin to accumulate and the reflection at the sending end will not be a true replica of that at the terminating end. In fact, the resistive load is changed to 220 ohms to compensate for a change of reflection coefficient due to line losses.

4. Any series or parallel combination of non-inductive resistance may be used to give 220 ohms; 30-watt total is adequate if keyed for short durations. A typical length of RG-8/U is 51¼ feet and is a quarter wavelength at 4,800 kc.

When the switch on the monitor unit is on the 8:1 position the indication should be in the green area of the monitor meter. On the 4:1 position it should indicate in the center position of the meter and in the 2:1 position, in the red area.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****AN/SRT-15, -16 EQUIPMENT HV CABLE FAILURES**

Failure of the high-voltage lead between the High-Level Radio Modulator MD-20/SRT and the High-Voltage Power Supply PP-1096/SRT and a method of replacing this lead was described in Electronic Information Bulletin 456.

Additional reports have been received from the field indicating further failures of high-voltage cables in AN/SRT-15, -16 Equipment. The high-voltage lead connecting the Low-Level Modulation MD-229/SRT and the Medium-Voltage Power Supply, PP-1095/SRT, has also failed.

As an emergency replacement, ignition cable can be used. A more suitable substitute, is to replace this lead with high-voltage wire N6145-635-7018 covered with 13/64-inch Belden braid, G-6145-191-8401, for shielding.

AN/SRT-15-16 -Refer to article on page AN/SRT-14:4

The shielding should be terminated 1 inch from each end and ground by lugged-pigtail connections.

AN/SRT-15, -16, REPLACEMENT OF HV POWER SUPPLY LEAD

Failures of the HV Power Lead to the high level modulator have occurred in the field. As an interim measure, it is suggested that a piece of high voltage test wire, FSN N6154-164-6969, be used as a substitute. This wire should be shielded with 1/2 inch Belden braid, FSN G6145-191-8401. In order to prevent end arc-over and heat damage, the shield should be terminated approximately 1 inch from each end of the lead and be grounded by pigtail lugged connections.

ORIGINAL**AN/SRT-15:1**

AN/SSQ-14-SYNCHRO SHAFTS SECURED TO COUPLINGS

Synchros used in AN/SSQ-14 equipment depend on friction alone to keep couplings and gears from turning on the synchro shafts. When synchro shafts slip in their couplings, erroneous roll and pitch correction data are transmitted to all antennas connected to the system.

A method of securing synchro shafts to couplings has been suggested. A hole is drilled and a dowel pin is installed parallel to the synchro rotor shaft through the notched opening in the locking washer and into the coupling or gear.

The modification prevents the coupling or gear from turning on the shaft, but it will not interfere with zeroing of the synchro. Synchros may be replaced at any time without further drilling or pinning.

Only the locking washer is to be drilled. Drilling of the synchro shaft is not authorized.

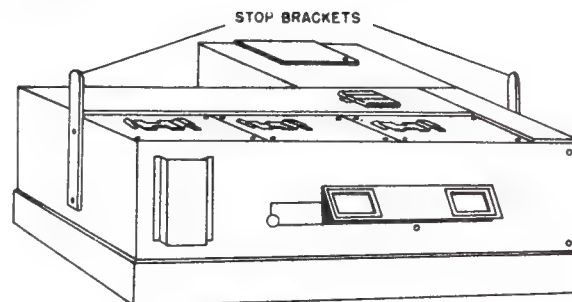
PROTECTION BRACKETS

The installation of two metal protection brackets on the Multiple Transmitter Distributor of the AN/TGC-1 equipment has been suggested. (See illustration.) The brackets are for the purpose of preventing damage to the tape retaining lids.

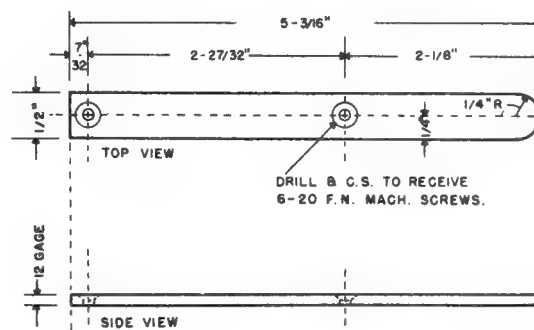
The suggested brackets (see fig. 1) allow the equipment operator to pull out the 2nd sliding tray supporting the typing reperforator without danger of damaging the open (upright) tape gates. (Damage to the tape gates throws the five code pins out of adjustment, the adjustment of these pins being critical to the operation of the AN/TGC-1 equipment). The stop brackets prevent the sliding tray from being pulled out beyond a safe distance by inexperienced personnel.

The brackets are installed by drilling two holes in each bracket, removing the two screws holding the side panels of the multiple transmitter distributor and using these screws to attach the brackets.

The suggestor points out that a bracket of other dimensions—longer or wider—of any strong metal would be suitable for protection to the equipment. This suggestion may be used at all activities where the AN/TGC-1 is in use to prevent similar damage to the equipment.



MULTIPLE TRANSMITTER DISTRIBUTOR



DRILL & C.S. TO RECEIVE
6-20 F.N. MACH. SCREWS.

STOP BRACKET
MATERIAL: STEEL

FIGURE 1.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****AN/TSA-11 AIR CONTROL GROUP**

INDMAN, 14ND, reported difficulty encountered in attempting to disassemble the AB-471/TSA-11 tower sections due to corrosion of the fasteners. The report recom-

mends application of DC-4 or anti-seize compound to the pins and barrels of the assembly upon initial installation and at periodic intervals to insure against corrosion and to prevent seizing.

AN/TXC-1(), TT-41()/TXC-1B DANGER OF ACCIDENTAL SHOCK

The following points out the danger of accidental shock from the exposed lug on the synchronous motor of the AN/TXC-1() and the TT-41()/TXC-1() facsimile transceivers when the housing for the motor and clutch assembly is removed. During normal servicing, power should not be applied to the transceiver with the cover removed. If emergency repairs modify

this safety practice, Mr. Berube suggests that insulating material be threaded over the wire lead and cupped behind the supports of the synchronous motor. The details of fabrication and installation are given in figures 1 and 2.

CAUTION: Power should be removed from the facsimile transceiver while the insulating material is being installed and removed.

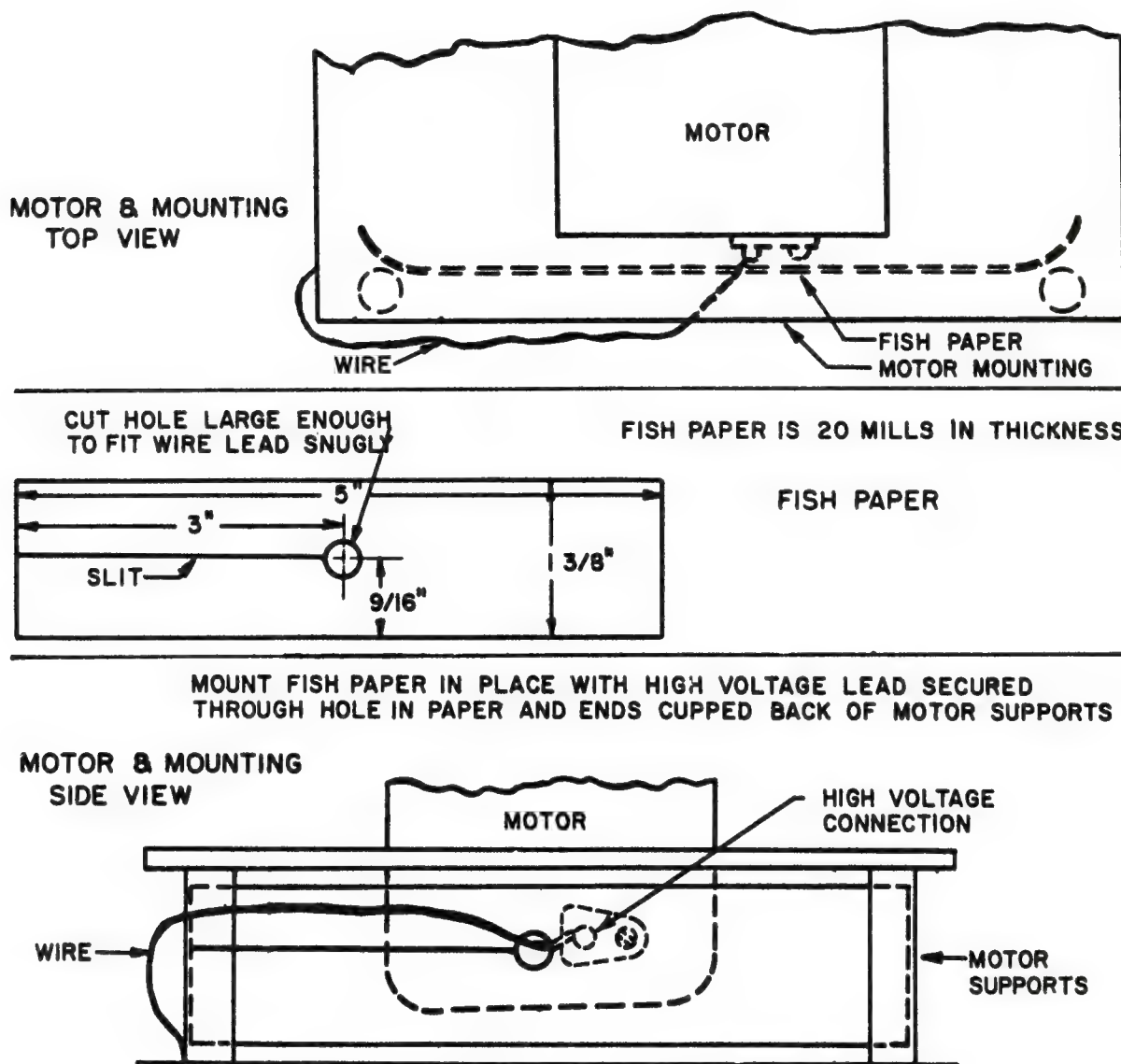


Figure 1

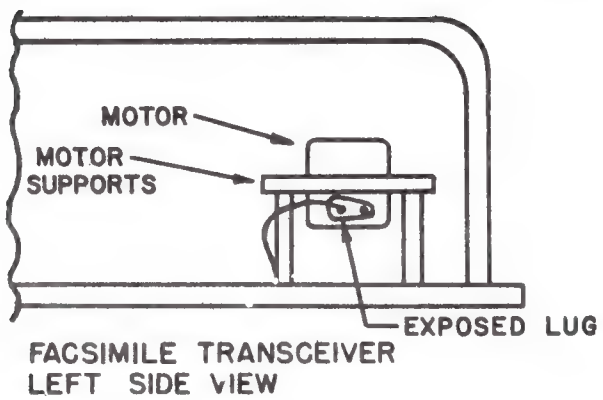


Figure 2

SERVICE NOTES**NAYSHIPS****900,000.1****COMMUNICATIONS****AN/UGH-1 CODE PRACTICE TRAINING KEYERS**

The Bureau is currently procuring a quantity of code-practice training keyers for use aboard ship to increase cw operator proficiency. These training keyers will provide a cw signal for receiving practice at various speeds. In addition, provisions are included for cw sending practice and signal-man "flashing light" practice.

These training devices are similar to the U.S. Naval Special Devices Center Model 8M-3, however, the standard AN nomenclature is AN/UGH-1.

ORIGINAL**AN/UGH-1:1**

**ELECTRIC SHOCK HAZARD DURING USE OF
AN/UNQ-7 RECORDER-REPRODUCER**

It has been brought to the attention of the Bureau that an electric shock hazard may be present during operation of the AN/UNQ-7 magnetic tape recorder-reproducer.

The AN/UNQ-7 was designed for permanent installation aboard ship and as such includes the facilities for grounding of the case through the base mountings. When installed in accordance with General Specifications for Ships of the U.S. Navy, section S60-0-j, the grounding provided will eliminate the shock hazard.

It is possible that either inadvertent painting or corrosion may destroy the effectiveness of this case ground strap. To correct this type of problem, proceed as follows:

1. Remove power from the machine.
2. Remove the ground strap which bridges across the left front (facing the machine) shock mount.
3. Burnish the ends of the strap and the case to assure good metal to metal contact.
4. Replace the ground strap and make sure that the applied torsion on the nuts establishes a good ground from case to base.

If the machine is used so that it cannot be installed as required by the standard installation instructions, a ground must be provided by (1) a ground cable between an unpainted chassis ground a ship's ground or an electrical outlet box ground, or (2) a third wire ground between the terminal board ground and the electrical outlet box ground.

AN/UNQ-7A

The Recorder-Reproducer AN/UNQ-7A manufactured by Midwestern Instruments of Tulsa, Oklahoma, has been found to have excessive "crosstalk" between channels. There are two methods of correction for this problem, depending upon the installation of the equipment. These corrections apply to all equipments prior to Serial Number 394 and are as follows:

1. **AN/UNQ-7A installed without remote control box connected.** If the remote control box is not connected to the equipment, the terminals 11, 12, and 13 on terminal board TB102 should be jumpered together.
2. **AN/UNQ-7A installed with remote control box.** If the remote control box is connected, the following instructions apply:
 - a. Replace the V802 tube with a 6201 (12AT7WA) tube.
 - b. Bridge terminals 11 and 12 on terminal board TB102 with a 2000-ohm resistor.
 - c. Recalibrate M402 (channel A) by adjusting R521 in accordance with instructions in the final **Technical Manual**, NAVSHIPS 365-2620, paragraph 5-44, on page 5-8.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****AN/UPN-12 RECEIVERS PROCUREMENT INSTRUCTIONS**

Many shipalts have been issued for accomplishment by forces afloat for the replacement of old LORAN receivers with AN/UPN-12 receivers. This equipment is in very short

supply and additional deliveries are not expected until 1960. Requisitions for AN/UPN-12 receivers should not be submitted without prior instructions from BUSHIPS. activity, local fabrication of the reflectors is recommended. No Field Change will be issued.

ORIGINAL**AN/UPN-12:1**

HINGE PIN SPRING MODIFICATION FOR AN/URA-8A AND -8B

Norfolk Naval Shipyard has pointed out that open control knob covers on the AN/URA-8A, -8B equipments are held in an upright position by the hinge-pin spring. These upright covers may cause damage by hanging in the wiring and resistor networks of the drawer above if the drawers are carelessly opened and closed during alinement and repair periods. This damage may be eliminated by clipping the hinge-pin spring in accordance with the accompanying figure. The covers will then drop into a closed position after control adjustments have been made. (See fig. 2.)

The adoption of this suggestion is left to the discretion of the individual activity. No field change will be issued.

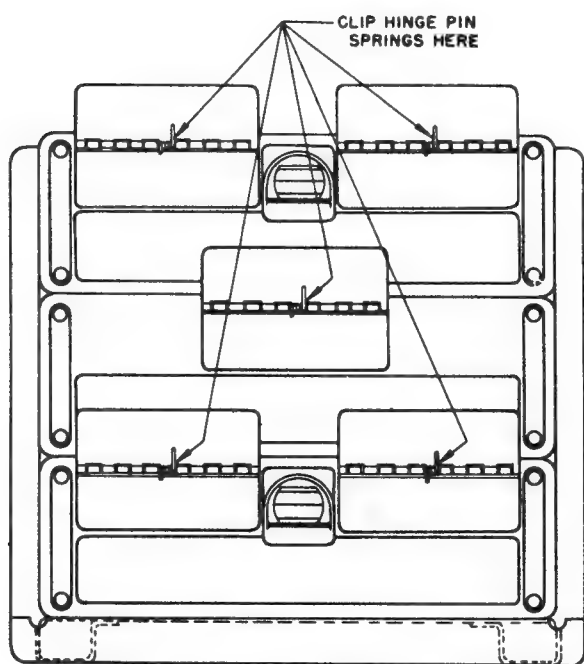


FIGURE 2. Modification of control knob covers.

AN/URA-8A, -8B DISCRIMINATOR TESTS

When the discriminator output voltages of the AN/URA-8A or the AN/URA-8B differ from the values given in Figure 2-3 of the instruction book, correct operation may be obtained by selecting, through trial and error, optimum vacuum tubes for V-102 and V-103. Any new tubes which are tried and found to be unsatisfactory should not be discarded, unless they are also found to be unsatisfactory in other equipments.

If proper performance cannot be obtained when the optimum tubes are selected for V-102 and V-103, the circuit components should be checked and any defective parts replaced. The resistors and capacitors may be checked with an ohmmeter and an impedance bridge.

Since transformers cannot be checked easily with an ohmmeter and impedance bridge, the following procedure is given for the test of T-102 and T-103:

1. Withdraw the converter-drawer assembly and connect the jumper cable.
2. Remove V-101 and V-103.
3. Set R-111 to its midposition.
4. Set the Mark-Space switch in the Normal position and the Shift switch in its Narrow position.
5. Connect a jumper from terminal 1 to terminal 4 of Z-103.
6. Connect an audio oscillator from terminal 1 to terminal 3 of Z-103. (Terminal 3 of Z-103 is grounded.) Adjust the audio oscillator for 1-volt output at 1000 c.p.s.
7. Connect a vacuum-tube voltmeter across terminals 3 and 4 of T-102; record the voltage at this point and disconnect the voltmeter.
8. Connect the vacuum-tube voltmeter across terminals 3 and 4 of T-103; record the voltage at this point and disconnect the voltmeter.
9. If the voltage readings differ more than 20%, substitute other tubes and repeat the tests. If the output voltage of one transformer is consistently low, replace the transformer with the lowest voltage.
10. Remove the jumper from the terminal 1 and 4 of Z-103; replace tubes V-101 and V-103.
11. Repeat the complete discriminator test; select the optimum tube for V-102 and V-103.
12. Replace the chassis in its cabinet and check the converter's performance on an incoming teletype signal.

MODEL AN/URA-8A/B FREQUENCY SHIFT CONVERTER ELIMINATION OF POSSIBLE DAMAGE

Commander, Destroyer Force U.S. Atlantic Fleet, provides the following information as pertaining to elimination of possible damage to AN/URA-8A/B: A possible cause of damage to teletype converters and source of cross talk in shipboard communications systems is the use of the 10-watt output of the RBS receiver. Use of the 10-watt output is not necessary because remote stations intended for voice reception are equipped with individual amplifiers. Damage to the input circuit of AN/URA-8A/B teletype converters (R101 & T102) may result from excessive input power.

Connection to the receiver transfer switchboard should be made to J-904 or J-905, which are located on the rectifier power supply unit of the RBS receiver, rather than to J-902, the 10-watt audio output.

Several ships of the Destroyer Force U.S. Atlantic Fleet have been wired to use the 10-watt output with resultant damage to teletype converters.

RELIABLE TELETYPE RECEPTION*

The Frequency Shift Converter/Comparator Group AN/URA-8A is employed with both high frequency (wide shift) and low frequency (narrow shift) transmission. Numerous cases of erratic teletype operation have been traced to improper tuning and adjusting of the AN/URA-8A. For such cases, it is believed that a better understanding of the present system of teletype transmission utilized by the Navy, together with the use of simplified tuning and adjustment procedures for the equipment, will greatly assist the technician in obtaining reliable teletype operation.

With the exception of UHF, practically all teletype transmissions made above 500 kc use the wide-space frequency-shift method, and all those below 500 kc use the narrow-space frequency-shift method. In the former method, the carrier is shifted 425 cycles above and below the mean carrier frequency for a total shift of 850 cycles, whereas, in the latter method, the carrier is shifted 90 cycles in the same manner for a total shift of 180 cycles. These frequency-shift limits are only approximate and will vary with different station transmissions. Moreover, a radio station may transmit teletype signals on 3 mc and 6 mc using the wide-spacing frequency-shift method and simultaneously transmit teletype signals on 100 kc using the narrow-space frequency-shift method.

On the Frequency Shift Converter CV-89A/URA-8A, two input receptacles are mounted on the rear of the cabinet. One is marked 600 OHM INPUT, WIDE SPACE, and the other, 6000 OHM INPUT, NARROW SPACE. For reception of a wide-space frequency-shift signal, the receiver output must be connected to the WIDE SPACE receptacle, and for reception of a narrow-space frequency-shift signal, it must be connected to the NARROW SPACE receptacle. On shipboard installations, only one connection is used from the audio patch panel to Converter AN/URA-8A. To eliminate the necessity of moving the plug from the WIDE SPACE to the NARROW SPACE receptacle when changing from one type to shift to the other, the manufacturer has installed a small jumper block so that, by placing the connections in the PARALLEL position, either wide-space or narrow-space frequency-shift may be used from either input plug. The jumper block (E102) is located on the left side of the discriminator submit near the front panel. It is recommended that this jumper block be placed permanently in the PARALLEL position for normal shipboard use.

For setting up Converter AN/URA-8A for wide-space frequency-shift reception, the following steps are recommended:

1. Connect receiver audio output to input of AN/URA-8A through audio patch panel.
2. Set KEYER control to TUNE position.
3. Set SHIFT control to WIDE position.
4. Set SPEED control to SLOW position.
5. Set CYCLE SHIFT control to 850 using the number on the outside line.

6. Adjust receiver tuning until pattern on CRT is as wide as possible (this tuning is rather critical).

7. Set KEYER control to OPERATE position.

8. Set MARK-SPACE control to either NORMAL or REVERSE position to produce intelligible copy. The setting of this control will depend upon which side of zero beat the receiver is tuned.

For setting up Converter AN/URA-8A for narrow-space frequency-shift reception, the following steps are recommended:

1. Connect receiver audio output to input of AN/URA-8A through audio patch panel.

2. Set KEYER control to TUNE position.

3. Set SHIFT control to NARROW position.

4. Set SPEED control to SLOW position.

5. Set CYCLE SHIFT control to 180, using the number on the inside line.

6. Adjust receiver tuning until pattern on CRT is as wide as possible (this tuning is rather critical).

7. Set KEYER control to OPERATE position.

8. Set MARK-SPACE control to either NORMAL or REVERSE position, to produce intelligible copy. The setting of this control will depend upon which side of zero beat the receiver is tuned.

The THRESHOLD control is to be adjusted to provide intelligible copy. Its setting is not very critical. The setting of the CYCLE SHIFT control does not materially affect the operation of Converter AN/URA-8A. It merely adjusts the width of the teletype pattern on the CRT by increasing or decreasing the signal level to the monitor scope. This pattern should be between the etched lines on the CRT; however, because of the manufacturer's tolerance of component parts, this setting may vary with equipments. The FREQ CPS and VOLUME LEVEL controls are used only in conjunction with teletype terminal equipment, such as the CF-1, and may be disregarded in a normal shipboard installation.

The complete AN/URA-8A usually consists of two Frequency-Shift Converters CV-89A/URA-8A and one Comparator CM-22A. For diversity reception, the output of each converter is connected to the input of the comparator. The teletype output of the comparator is connected to the teletype patch panel (TT-23-SG). On some shipboard installations, the teletype outputs of the converters are also wired to the patch panel. Either converter or comparator keying may then be selected by the use of patch cords.

A few of the more common troubles that may develop in the AN/URA-8A are listed below:

Symptom	Trouble
Low or no line current	Defective keyer tubes V207, V208; defective trigger tube V205; defective rectifier tube V401.
Teletype garbled	Defective tubes; MARK-SPACE control in wrong position; improper tuning of receiver.

*Adapted from the March-April 1957 Issue of Philco's Tech Rep Division Bulletin.

SERVICE NOTES

NAVSHIPS

900,000.1

COMMUNICATIONS

Inability to obtain a teletype pattern or full width on CRT

CYCLE SHIFT control improperly set; receiver improperly tuned; defective tubes.

Unit does not turn on

Defective fuses F502 and F501 (located on bakelite panel inside unit).

FUSES IN FREQUENCY SHIFT CONVERTER-COMPARATOR AN/URA-8A EQUIPMENTS

The AN/URA-8A equipment consists of two frequency shift converters and one comparator. Each converter is separately fused with two ¼-ampere fuses. The comparator is fused with two ½-ampere fuses.

Under certain conditions due to heat generated in the completely enclosed spaces of the equipment, it has been found that the present fuses are not of sufficient capacity to prevent an occasional failure.

Where this condition exists, the following fuses (Symbol Nos. F-501, F-502, F-901, F-902 and their replacements F-503, F-504, F-903, and F-904) should be replaced with 1 ampere cartridge fuses which have the following description:

(a) Fuse, cartridge, 1 amp., opens in one hour at 135% rated load at 25° C., continuous at 110% rated load; 250 volts, 1 time, glass body; 2 ferrule terminals; 1¼" lg. x 9/32" dia. O/a. NEC Std 4AG, Mfg. Bussman.

REPAIR OF SUB-UNITS IN FREQUENCY SHIFT CONVERTER-COMPARATOR AN/URA-8A AND AN/URA-8B

Reports of failure of sub-units in the above equipments have been brought to the attention of the Bureau of Ships. When a failure occurs, an Electronic Failure Report shall be completed and forwarded to the Bureau of Ships. The

defective sub-unit should be replaced by a sub-unit from the equipment spares. The defective sub-unit should be returned to an electronic shop (a tender or shop 67 in shipyard) for repair and return to stock only if repair to defective unit cannot be effected on ship.

Equipment spares supplied with each Frequency Shift Converter-Comparator Group AN/URA-8A and AN/URA-8B consist of one each of the following sub-units:

- Converter Discriminator
- Converter Oscillator-Keyer
- Converter Monitor
- Converter Power Supply
- Converter Cable Filter Assembly¹
- Comparator Selector Unit
- Comparator Power Supply
- Comparator Cable Filter Assembly¹

A requisition for a new sub-unit should include the following: Sub-unit is to replace a defective sub-unit not repairable aboard ship. Defective sub-unit sent to for repair and return to stock.

REFLECTORS FOR VIEWING OSCILLOSCOPE TUBE OF AN/URA-8A

The use of special reflectors on the frequency shift converter units installed in the Communications Central AN/MSC-3 has been suggested. Their purpose is to permit the operator of the associated communications receiver to observe the monitor scopes during the tuning procedure. The principle is applicable wherever space limitations necessitate locating the Frequency Shift-Converter - Comparator Group AN/URA-8 away from direct view.

Figure 1 shows the manufacturing details and the use of the device as covered by this suggestion. The versatile design, simple construction and low cost may well justify its use in other applications where similar installation conditions exist. Since requirements will depend upon the extent of application at each

¹Cable filter assemblies for AN/URA-8B are not interchangeable with those of the AN/URA 8A. 12/1/52

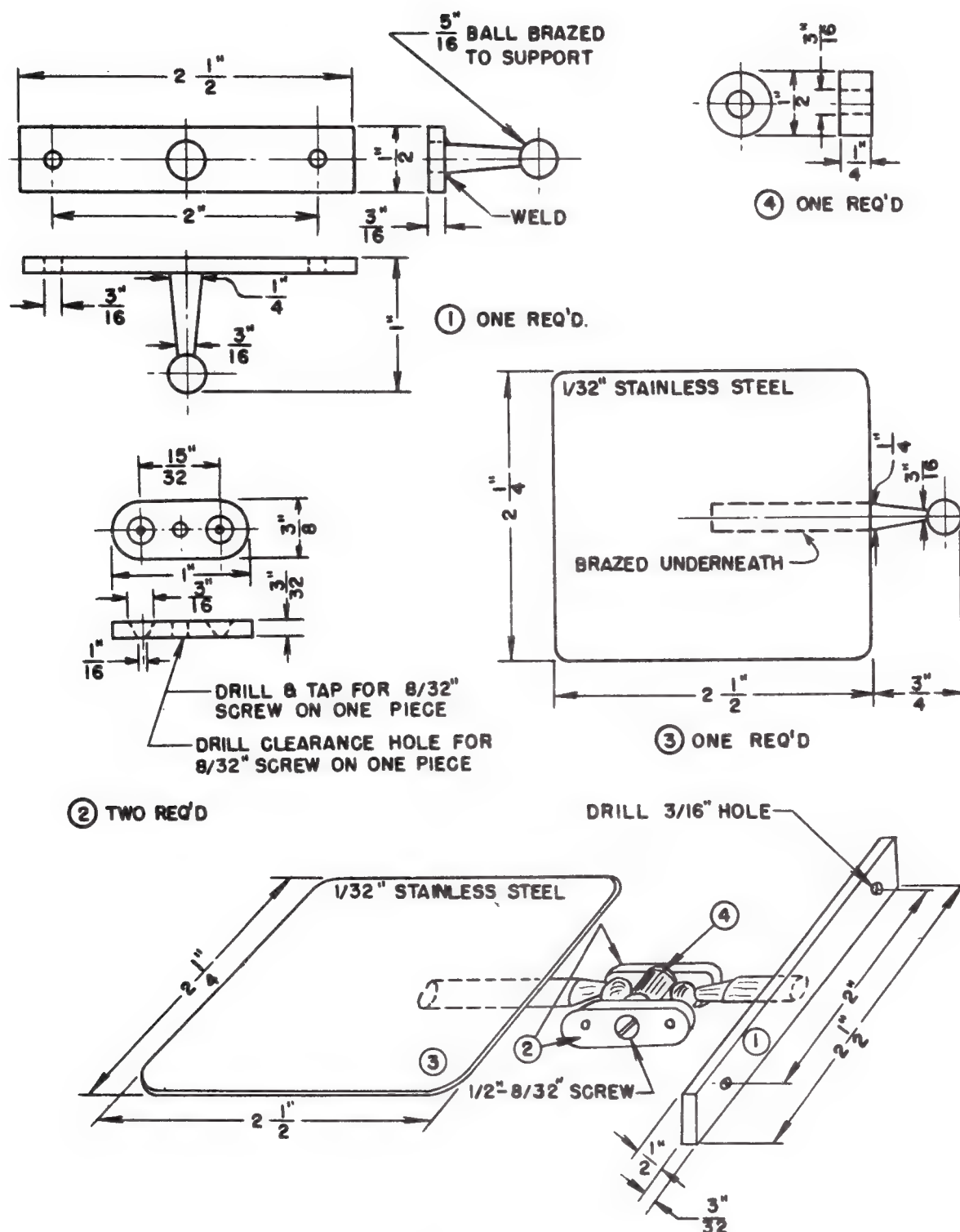


FIGURE 1. Reflectors for viewing oscilloscope tube.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****AN/URC-16, -17, -18 RADIO SETS AVAILABILITY OF
BAG COVER CW-330/GR**

A protective bag cover, CW-330/GR, FSN N5820-330-9654, is now available for portable Radio Sets AN/URC-16,

-17, -18 through normal supply channels. This cover is designed to prevent water damage to these equipments when exposed to inclement weather.

ORIGINAL**AN/URC-16:1**

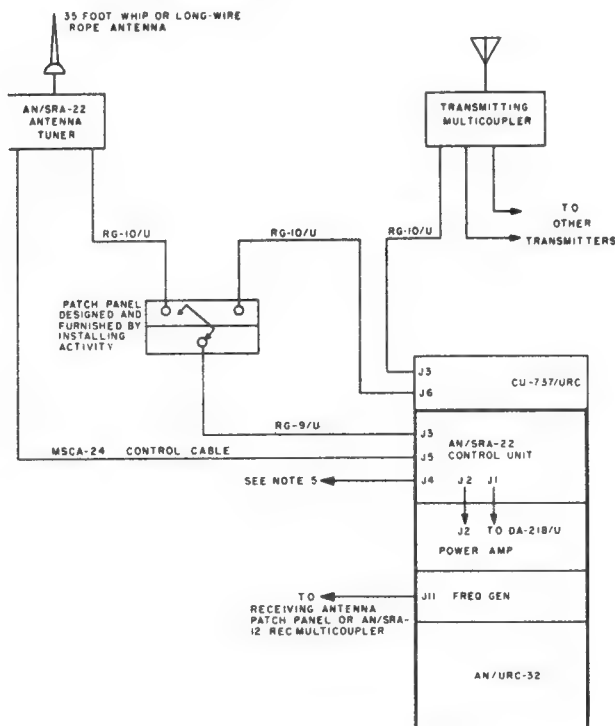
AN/URC-32 - USE OF COUPLER-MONITOR CU-737/URC ACCESSORY

The Coupler-Monitor CU-737/URC (Collins model 180U-2), as accessory for Radio Set AN/URC-32 was initially procured for submarine use. This unit primarily provides circuitry for transmission line impedance matching, a monitor speaker, an RF wattmeter and is provided for use with submarine antenna tuning systems such as the AN/BRA-3 and AN/BRA-5.

Recently, there have been requirements for the AN/URC-32 to operate with transmitting antenna multicouplers and the Antenna Coupler AN/SRA-22 on surface ships.

Figure 1 provides the typical system interconnection for this purpose. The control unit for the AN/SRA-22 shall be installed in the AN/URC-32 rack in the space provided and the CU-737/URC shall be located close to the AN/URC-32 for convenience in tuning. Figure 2 indicates the preferred method of mounting, if space permits.

Since the CU-737/URC was not originally intended to perform this system function, the equipment modifications as noted on Figure 1 notes must be accomplished. When the AN/SRA-22, CU-737/URC system is used, it is preferable to provide a separate receiving antenna to the AN/URC-32 receiver antenna input.

**Figure 1****Figure 1 Notes:****1. CU-737/URC**

a. Disconnect interval connections to J4 and J5. Assemble cable and connectors to connect J4 and J5 direct.

Remove switch S3, associated wiring and blank-off front panel hole and switch position indicators.

b. Remove antenna relay K1, connector P1 and connect transmission line from patch panel to J6 of the CU-737/URC.

c. From terminal board J8, connect speaker leads 3 and 4 to terminals 3 and 4 of terminal board TBH in the AN/URC-32 junction box. This will provide a local speaker-monitor.

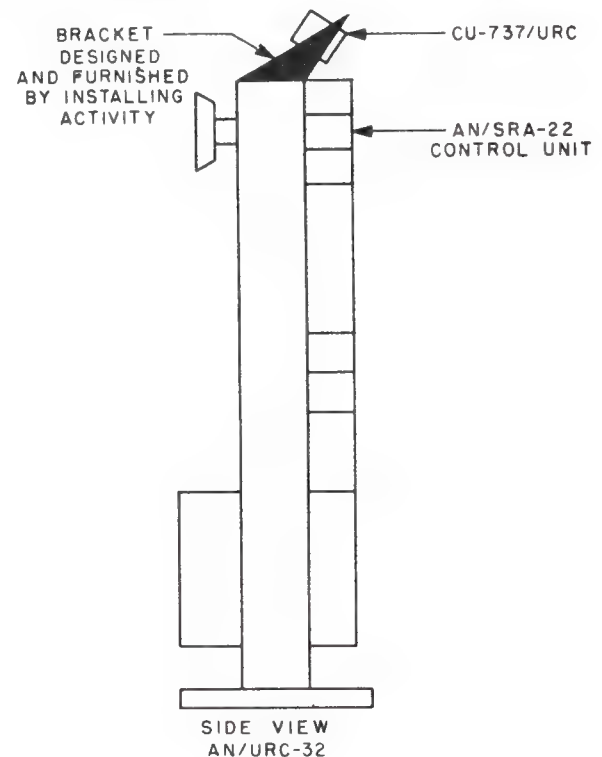
2. AN/URC-32

a. Remove 680 ohm resistor from junction box terminals G5-G6.

3. Since there are two wattmeters, one in the CU-737/URC and one in the AN/SRA-22 control unit, there will be two meter indications when the AN/URC-32 is used with the CU-737/URC-multicoupler system—only one metering system need be used for tuning.

4. The AN/SRA-32 control unit controls are only used with the associated tuner when the AN/URC-32 is patched through to the tuner.

5. The AN/SRA-22 control unit receiver output receptacle J4 may be cabled to (or through a patch system) J11 on the AN/URC-32 for receiving on the same antenna as used for transmitting.

**FIG. 2****AN/URC-32: SHOCK AND VIBRATION MOUNT INSTALLATION**

Recent photographs received in the Bureau indicate several installations of the shock and vibration mounting

supplied with radio set AN/URC-32 are being improperly installed. These photographs show off-the-deck mounting on inverted "L" steel angles with no bed-plate.

The shock and vibration mounting unit supplied with the AN/URC-32 should be mounted on a flush surface for proper operation. If it is necessary to mount the equipment off-the-deck by means of angle supports, a steel bed-plate must be provided that will permit complete support of the entire shock and vibration mount base.

AN/URC-32 & AN/URT-18 ALINEMENT OF REFERENCE OSCILLATOR

Many of the reference oscillator plug-in (module) units of the Radio Set AN/URC-32 and Transmitter AN/URT-18 have been reported inoperative and turned in for repair. After investigation, it has been disclosed that many of these units could have been restored to service locally through an alinement process.

The equipment contractor, in conjunction with the field service engineer, has evolved an alinement procedure for application by fleet personnel. It is recommended that this alinement process be employed, if possible, prior to sending the units into a module repair activity, in order to reduce unnecessary costs and attendant problems.

TEST EQUIPMENT REQUIRED:

Oscilloscope OS-8/U, or equivalent.

AN/USM-34 vacuum tube voltmeter, or equivalent.

MK-447/URC-32 tool kit (supplied with AN/URC-32 and AN/URT-18).

PROCEDURE:

1. Measure the 100-kc. signal at J1 of the Frequency Divider Module. This level should be 1.0 to 1.5 VAC (RMS). Measure the 2400-kc. signal at J1 of the Sidestep Oscillator module. This level should be 0.5 VAC (RMS). If these values or signals are not as stated, or missing, proceed with the following alinement procedures.

NOTE: Loss of the 2400.kc. signal will cause the stabilized master oscillator to operate as a free-running oscillator, so that the equipment will be operating off frequency.

Loss of the 100-kc. signal will render the equipment inoperative except in the AM receive mode. Either of these conditions will exist if the Reference Oscillator is inoperative. A "noisy" 100-kc. signal may be noted in the AN/URC-32 receiver as excessive hash and lack of any desired receiver audio signal. Loss of the Reference Oscillator signal will cause the AC meter to remain at zero.

2. Plug in a spare operative Reference Oscillator from the MK-464/MRC kit, if available, and double check scope and ac signal levels from the operative unit.

3. Synchronize the scope for good ac display of the signal that was found improper on the inoperative Reference Oscillator module in step 1.

4. Remove the working module and reinsert the unit determined as being inoperative.

5. Using the oscillator alinement cover found in the MK-447/URC-32 tool kit, and the extension pendant cable

marked for use on the Oscillator 100 kc. (Collins part number 544-9031), remove the inoperative Reference Oscillator module and place the test cable in J1 with side marked "A" to terminal "A" of J1.

CAUTION: "A" on the opposite end of the test cable must also go to terminal "A" of P1 on the Reference Oscillator module.

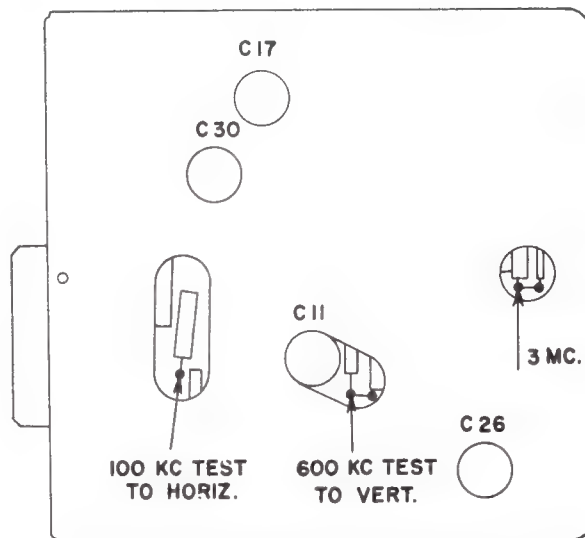
6. Remove the cover closest to P1 of the Reference Oscillator and place the test alinement cover on the module before attempting the variable capacitor adjustments.

7. Connect the oscilloscope to the 100-kc. and 600-kc. test points as shown in figure 1. Adjust C17 and C30 for a well-balanced 6-to-1 Lissajous figure with maximum amplitude. Tuning of C17 and C30 will readily show the position at which the best figure display will be seen. Adjust C11 for maximum amplitude of the 6-to-1 figure. Tuning of C26 will cause the figure to run off the scope to the left or right. After doing this, the proper setting of C26 will be apparent. At this setting there will also be a very slight increase in the amplitude of the 6-to-1 figure. If the 6-to-1 figure is obtained, it is known that the 2.4 mc. signal and the 100-kc. signals are present and the above adjustment will have peaked the 2.4-mc. signal.

NOTE: Only minor adjustments of these capacitors will be necessary and, if step 6 does not render the module operative, component troubles may exist and the module should then be turned in to a supply center (see BUSHIPS Instruction 9671.22, serial 623A5-2377 of 14 September 1960), for forwarding to a module repair activity.

8. Field alinement of L1 on the Reference Oscillator module should be attempted only when WWV or a known high stability reference signal is available (100 or 1000 kc.). If not available, the procedures listed in the equipment technical manual should not be attempted. (Refer to

TEST POINTS AS VIEWED THRU ALIGNMENT COVER



ORIGINAL

the L1 alignment procedure as listed in the frequency comparator unit section of the manual).

AN/URC-32 High Voltage Power Supply Fuse Failure

Recurring failures of fuse F3 in the high voltage power supply of AN/URC-32 has resulted in additional research by the manufacturer. It has been found that the front panel interlock shorting switch (S7) is at fault. This switch is located on the same bracket as the front panel interlock microswitch (S8). Shorting switch (S7) is directly above microswitch (S8).

At the point where the wire carrying high voltage from C49 is connected to the porcelain insulator the high voltage will occasionally arc to the bracket supporting the insulator causing fuse F3 to blow. A new bracket has been devised which provides more spacing between the insulator and the bracket. These will appear on AN/URC-32, commencing with serial 360, with at least 1/8-inch spacing to prevent this arcing. To accomplish this on models prior to serial 360, the following procedure is suggested:

1. Remove from the panel the ventilating cover of power amplifier.
2. Remove two small Phillips-head screws that hold bracket to chassis. This will permit access to the screw that holds the porcelain insulator to the bracket.
3. Loosen screw holding porcelain insulator to the bracket; move insulator over as far as possible from side of bracket and tighten screw.
4. Replace bracket and switches. If clearance does not appear to be sufficient, further spacing may be gained by applying pressure between bracket and insulator, thereby slightly bending the bracket and forcing the far end of the insulator away from the bracket.

AN/URC-32 General Notes

Periodically, requests for information, comments from the fleet, notes from field-engineer reports, etc., include information of general interest to all users of Radio Set AN/URC-32. The following such notes are provided for information and use.

Installation information—A list of stock numbers which may be useful in requisitioning of necessary installation material:

Equipment	Stock number
MSCA-24 Cable	G6145-184-5862 or G6145-542-6894
MSCA-10 Cable	N6145-184-5863
DSGA-9 Cable	G6145-184-5893
TTHFWA 1-1/2 Cable	G6145-184-1253
RG-10/U Cable	N6145-161-0883
RG-10A/U Cable	N6145-161-0884
RG-18/U Cable	N6145-195-8724
RG-18A/U Cable	N6145-635-9915
Type 66047 Whip Antenna	N5985-349-5340
Type IL-18/U Insulator	N5970-681-3018
Type 61335 Insulator	N5970-284-8084

NOTE: RG-10()/U cable is normally used on antenna runs up to approximately 100 feet. On runs in excess of 100 feet the RG-18()/U cable is normally used.

Equipment warranty—The AN/URC-32, AN/SRA-22, and accessories have a manufacturer's warranty for a period of one year after delivery to the Navy. Any electrical or mechanical failure on new equipment attributed to a manufacturing defect should be reported to the Service Force Commander.

MK-446A/URC-32—This unit is used only in installations where access to the high-voltage power supply on the rear of the AN/URC-32 is not possible. This unit permits mounting the power supply remotely from the equipments mounting rack. Existing stock of the unit has been depleted. Ships and activities requiring the use of the unit may manufacture locally using BUSHIPS Plan RE 43D2024B, when the fabricated unit is not available.

Sideband selection—For proper sideband selection, operate switch on the Audio and Control Unit (AM-1062/URT) to either the upper sideband (USB) or lower sideband (LSB) position, for operation as required by the operational communications plan. Communicating with stations on the opposite sideband is not possible.

Tool allowance—Several ships have recommended that the AN/URC-32 be supplied with a small tool such as a surgical hemostat for use in repair work and as a "heat sink." These items (hemostats) are on every Electronics Tool Allowance List. Ships not having these tools for electronics work should requisition them from the supply system.

Printed wiring boards—Use only a low-wattage soldering iron such as that supplied in the MK-447/URC-32 accessory toolkit. Solder irons or guns generate more heat than is required to melt the solder on printed wiring connections and, if used carelessly, could cause damage to the printed circuit board and components. Use 60/40-type solder. Module repair techniques are provided in the AN/URC-32 technical manual (page 49, para 5.7, NAVSHIPS 93285). Additional information concerning printed wiring board procedures and techniques was provided in an article of March 1959 issue of the Bureau of Ships Journal.

Power amplifier tubes—Ships have reported the replacement of the 4CX250B final amplifier tubes with type 4X150 in emergencies where the 4CX250() version was not available. This operation is possible and results in a lower power-out-put from the equipment. Temporary tubes should be replaced with the proper types, upon availability. Whenever final amplifier tubes are replaced, neutralization, bias, and balance checks should be made in accordance with the technical manual (page 4, power amplifier section of NAVSHIPS 93285) instructions to assure proper operation.

Radio Sets AN/URC-32 being supplied under contract NObsc (delivery commencing August 1960) will include type 7580 final amplifier tubes. The 7580 is a later version of the 4CX250() series and is interchangeable. Backfitting of the existing 4CX250() series is not necessary. Replacement with type 7580 is recommended, upon failure. The 7580 is a more reliable military design.

P & O reports—When submitting P & O reports on the AN/URC-32, include the associated AN/SRA-22, CU-737/URC (if used) report serial numbers. These reports may be submitted for a period of six months, then terminated, unless the equipment has unusual failures that should be brought to the attention of the Bureau. On one report, it is requested that information be included, whether the equipment was installed by ship's force or shipyard.

Equipment repair parts provisioning procedures—For information concerning procedures in obtaining equipment-onboard repair parts, reference should be made to the Electronics Supply Office publication Electronic Repair Parts Allowance List, Processing Guide, ESO Instruction 4441.17C.

Latest Allowance Parts List dates:

AN/URC-32	April 1960
AN/SRA-22	Oct. 1959
CU-737/URC	April 1960

Antenna tuners—Although the Antenna Coupler AN/SRA-22 was designed specifically for use with the AN/URC-32, it is possible to use the AN/SRA-18() unit. Detailed tests conducted by NEL have shown that the AN/SRA-22 is a more efficient and preferred unit. For emergency situations or when the AN/SRA-22 is not available, temporary use of the AN/SRA-18 should be considered.

Sidetone for CW operation—To adjust the audio sidetone in the CW mode, adjust the potentiometer R205 on the speaker-amplifier module contained within the AM-2062/URC (159-1 Audio and Control) chassis to the desired level (see pages 6 and 11 of the audio and control unit section, NAVSHIPS 93285, AN/URC-32 Technical Manual.) Note also that this module contains a fuse (F201) for the 24 vdc transistor supply and should be checked when there is an indication of no audio output from this unit. Sidetone operation may be disabled, when desired, by operating the sidetone ON-OFF switch located behind the dust cover on the sideband generator (AM-2064/URC) chassis.

Issue of accessories—The current authorized allowance issue of equipment accessories is one set of spare modules (MK-464/URC, Maintenance Kit) for each three equipments installed on board and one tool kit (MK-447/URC, Maintenance Kit) per ship. Ships currently having an excess of this allowance are being directed to forward the excess to a naval supply center. The modules contained within the MK-464/URC forwarded to the supply center will be individually stocked for issue, on requisition, to ships requiring a unit to replace a defective one. Ships receiving a replacement unit will be directed to forward the defective unit to a repair facility (NAVREPFA, San Diego, or Norfolk Naval Shipyard, Restoration Coordinator), via a supply activity for repair and return to the stock supply system.

Equipment training—Bureau of Naval Personnel Instruction 1500.25 and catalog NAVPERS 91769D contain information concerning available training courses. Quota information should be obtained from the Commanding Officer, Enlisted Personnel Distribution Office, U.S. Atlantic Fleet or U.S. Pacific Fleet, via the Type Commander.

Remote operation—When remote control of the AN/URC-32 is desired in the ships-standard-radio-remote-control system it is only necessary to operate the switch marked "REMOTE-LOCAL" on the Handset Adapter Chassis C-2691/URC, to the "REMOTE" position. The switch marked "TUNE-LOCAL-REMOTE" on the sideband generator chassis should not be operated. Operating this switch will not permit keying of the equipment from a remote position. This switch performs the following functions:

TUNE position—Disconnects external audio input signals and reinserts a carrier signal for tuning the power amplifier.

LOCAL position—Normal operating position after equipment is tuned and ready for operation.

REMOTE position—Not used. This switch permits the remote operation of the receiver RF gain control and the TGC-AGC meter indicator. This capability is not available in the existing ships-standard-radio-remote-control system. **DO NOT OPERATE THIS SWITCH TO "REMOTE" POSITION.**

High replacement item stock numbers—Stock numbers for items with a high-replacement rate follow:

High-voltage fuse F3	N5920-232-3691
20-amp line fuse	N5920-296-4885
4CX250B tube	N5960-615-4376
20L diodes	N5960-542-7040
1N1084 diodes	N5960-552-7817

Attention is invited to the revised ESO Allowance Parts List (APL), dated April 1960. The APL for the AN/URC-32 has been revised by ESO to include items inadvertently left out of the original issue.

Caution-antenna tuning—Reports being received indicate that some ships inadvertently are burning out receiver front-end coils by tuning up a "back-up" transmitter, in high power, and on the same frequency to which the AN/URC-32 is tuned. With the close proximity of shipboard antennas, this amounts to "pumping" a large amount of RF directly into the receiver, causing the resultant receiver-coil failures. When tuning other equipments to the same frequency, it is recommended that this be done with low or tune power, and that the receiver-antenna-input-transmission line of the AN/URC-32 be temporarily disconnected to eliminate this equipment failure. Future AN/URC-32 equipments will be provided with an antenna protective device that will disable the receiver when excessive power is encountered on the transmission line. Field change kits to back-fit equipments procured under contract NObsr 75279 have been initiated, and information on their availability will appear in the EIB.

Ships force and activities installing the AN/URC-32 equipment (and the Antenna Coupler AN/SRA-22) should investigate thoroughly the proposed antenna location to provide as wide a separation as possible between adjacent antennas. Alternately, though least desirable, due to attenuation, etc., the equipments-receiver-antenna input (on frequency-generator chassis) could be cabled to the ships-receiving-antenna-distribution system (patch panel, multicoupler, or direct).

Stock number—The stock number for the CU-737/URC Coupler-Monitor has been changed to FSN F5985-678-4053.

"Off-frequency Reports — A number of off-frequency reports received by ships have been attributed to improper switching in the SW and FSK modes. When operating in these modes, assure that the frequency-indicator dial on the frequency-generator unit is set **2kc. below the assigned frequency** for FSK operation, and **1 kc. below the assigned frequency** for CW operation, and that the appropriate position of the OSC CONTROL switch on the CW/FSK unit is used. Switch to the **CW 1 kc.** position when the assigned frequency is an even-numbered frequency (i.e., 3000.00 kc.) and to the **CW 1.5 kc** position for a 500 cycle-increment assignment (i.e., 3000.5 kc.)."

The instructions as provided in the Technical Manual, Operators Chart, and stenciled on the front cover of the equipment frequency-generator unit are correct.

The AN/URC-32 is capable of operation in all modes on 1 kc. increment-frequency assignments and 500-cycle increments in the CW mode.

AN/URC-32—Use of Isolation Amplifier Module

The Bureau has been receiving requisitions for the Isolation Amplifier Module as described on page 10 of the Frequency Generator section of NAVSHIPS 93285 (AN/URC-32 Technical Manual). Currently, the use of this module is not required.

The Isolation Amplifier Module is to be installed only in specific equipments requiring the use of the AN/URC-32 in future, highly sophisticated, communications systems (i.e., for data handling etc.) This module is installed in the equipment in place of the existing Reference Oscillator Module and is connected to a highly stable ships-frequency source such as Standard AN/URQ-9 Frequency.

Upon availability and installation of the AN/URQ-9, ships requiring the use of the AN/URC-32 for conventional communications (SSB, AM, CW, FSK) shall connect the AN/URQ-9 output to the AN/URC-32 frequency comparator chassis jack J2. The signal from the AN/URQ-9 shall be used as a frequency standard for calibrating the AN/URC-32 internal frequency standard, within the reference oscillator module.

The Isolation Amplifier Module has recently been assigned the nomenclature AM-1785/GRC and the Federal stock number F5820-715-6393.

AN/URC-32 Performance and Operational Reports

At the request of CNO, ships submitting Performance and Operational Reports for Radio Set AN/URC-32 are requested to supply additional informational data in the "Remarks" column. Data relative to the approximate equipment time used in the SSB, CW, AM, and FSK models is desired.

*The CU-737/URC is normally an accessory for the AN/URC-32 and used only in submarines and antenna multicoupler installations. ESO is currently revising the AN/URC-32 APL to exclude the CU-737/URC.

It has been noted that a number of ships are erroneously reporting equipment "not in operating condition" time. The space provided for "Hours Not In Operating Condition During Report Period" should only show the time the equipment was not in an operational-ready condition due to an equipment failure. A review of submitted reports indicate the hours being reported include the time the equipment has been turned off and not in use.

BUSHIPS is analyzing all reports concerning this equipment and it is noted that a number of ships having the AN/URC-32 aboard have not submitted the required P & O Reports. Electronics officers are requested to assure submission of these reports.

AN/URC-32 Equipment Allowance Parts List

The following tabulation is for information in identifying the various chassis of Radio Set AN/URC-32 when using the Electronics Supply Office Allowance Parts List (APL).

APL Unit Number	AN Nomenclature	Collins Type Number
1*	CU-373/URC, Monitor-Coupler	180U2-Antenna Network
2	AM-2061/URT, RF Amplifier	Power Amplifier 367-A
3	CV-731/URC, Converter-Osc.	786-1 Freq. Generator
4	AM-2064/URC, Amp- Conv-Modulator	786F-1 Side Band Gen.
5	CV-730/URC, Converter-Monitor	CW-FSK Unit
6	AM-2062/URC, Amplifier-Control	159B-1 Audio & Control Unit
7	CM-126/UR, Signal Comparator	54Q-1 Freq. Comparator
8	C-2691/URC, Control Power Supply	Handset Adapter
9	H-169/U, Handset	Handset
10	PP-2154/U, Power Supply	42B-1 Low Voltage Power Supply
11	HD-347/U, Cooler, Air	199G-3 Blower
12	PP-2135/U, Power Supply	428B-1 High Voltage Power Supply

AN/URC-32-SUBMARINE ANTENNA SYSTEM INSTALLATION DRAWING

BUSHIPS Plan RE43D2015() has been superseded by BUSHIPS Plan RE47H2015(). RE47H-2027 is the equipment system installation plan for Antenna Tuning Group AN/BRA-3, AN/BRA-5. Sheet 3 of this plan shows system interconnection for the AN/BRA-3, -5 with Radio Set AN/URC-32.

AN/URC-32-INSTALLATION INFORMATION

Ships and activities planning the installation of Radio Set AN/URC-32 and making use of the MK-446A/URC-32 Installation Kit should ensure that the high-voltage power supply will not be located in spaces where the ambient temperature will exceed 160° F. When the MK-446A/URC-32 is used, the high-voltage power supply is removed from the equipment rack, and away from the equipment's blower system. The manufacturer has advised that this power supply will operate satisfactorily without air supply to temperatures of 160° F.

The AN/URC-32, as shipped, has the CW break-in delay control set for MAXIMUM lag. Ships and activities installing the AN/URC-32 should refer to the equipment technical manual (CW/FSK unit) and make adjustments for the desired CW break-in relay hold-in time.

To eliminate AN/SRA-22 equipment damage, a detailed verification of cable connections and continuity should be made prior to applying power.

AN/URC-32-P & O REPORTS

Radio Set AN/URC-32 and Antenna Coupler AN/SRA-22 are now being installed on many ships. The submission of Performance and Operational Reports on this equipment is required.

The reports have many advantages. They provide the Bureau with an accounting of equipment serial numbers, a report on how new equipment is performing and the "Remarks" column is for the purpose of outlining "gripes" and providing additional equipment performance data.

REMEMBER—if the Bureau does not receive the P & O reports, it is not always aware of the new equipments operational performance or failure and consequently, is not able to assist in providing field changes on equipment modifications.

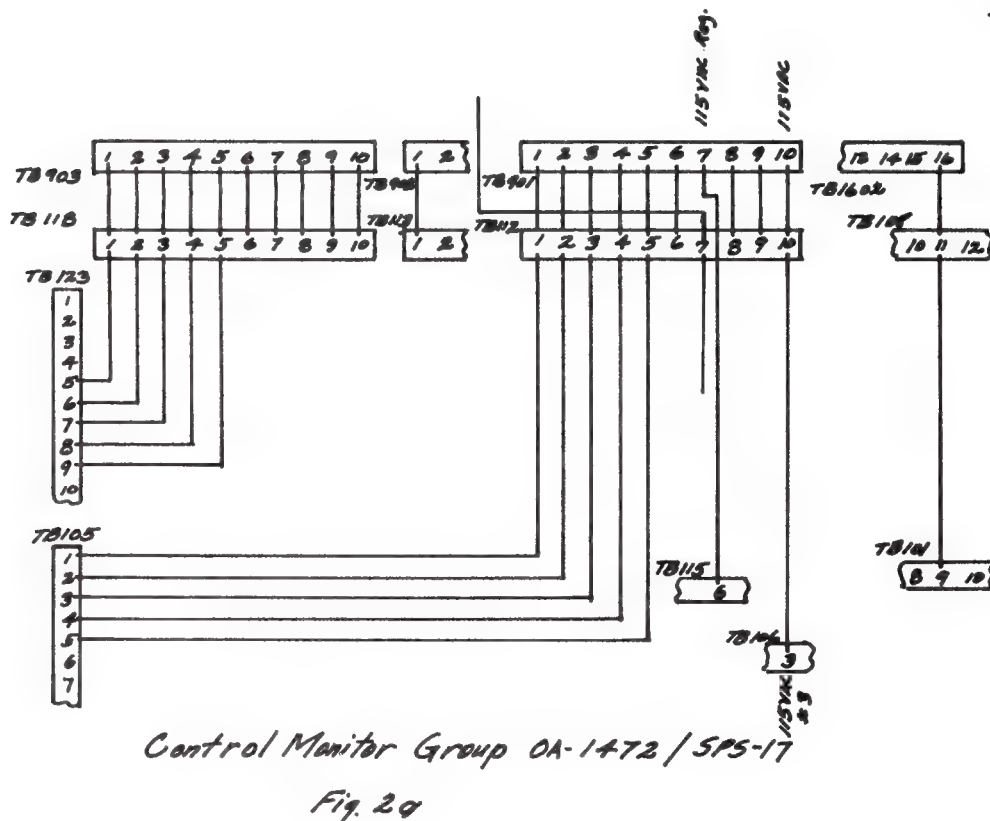
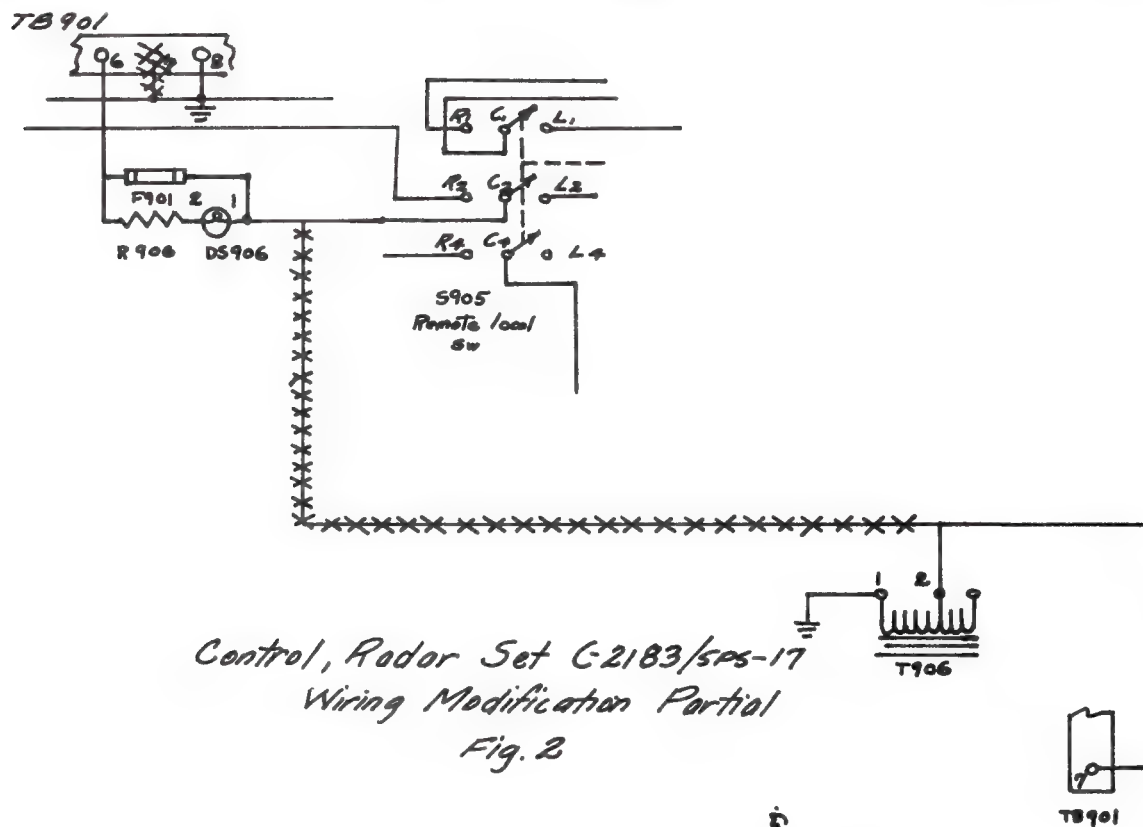
Reports for the AN/URC-32 and AN/SRA-22 may normally be submitted as unclassified.

RADIO SET AN/URC-32-PRODUCTION WIRING ERROR

A production line wiring error within the equipment Interconnection Box J-1007/U of Radio set AN/URC-32 Serial Number 109 has been reported.

Upon pre-installation check of AN/URC-32 Serial 109, it was found that the blower motor in Antenna Coupler CU-714/SRA-22 was not operating when the transmitter was keyed. In checking the cause of this discrepancy, it was found that the terminal board jumper lead from terminals H-13 and M-7 was connected between terminals H-13 and K-7 instead, and the blower motor was not being energized when the transmitter was keyed. Upon connecting the lead between terminals H-13 and M-7 the blower motor operated satisfactorily.

All ships and activities having Radio Set AN/URC-32 should remove the Interconnection Box J-1007/U dust cover and verify the jumper wire connection between terminals H-13 and M-7. It is requested the Bureau of Ships, Code 687D, be advised of any wiring error discovered and the equipment serial number.



AN/URC-32; L-32 OF RF TUNER (MODEL B) UNGROUNDED

A very small quantity of Model B RF Tuners, FSN 5820-799-7433, may have been released as spares without having L-32 grounded. These carried the manufacturer's serial numbers 101 to 130. This trouble can be identified by lower than-normal exciter RF gain when the tuners are installed in an AN/URC-32. Also a visual inspection of L-32 can be made to determine whether or not L-32 is grounded. Ships having spare RF tuners (Model B) withing the above manufacturer's serial numbers should inspect and if necessary replace the missing ground wire.

AN/URC-32—ELIMINATION OF RECEIVER INPUT INTERFERENCE

Ships have reported elimination of receiver interference (due to radar, etc.), through the use of a filter network that is in the supply system. This filter (stock No. N5915-615-5827) was originally supplied in the AN/SRA-20 antenna tuning equipment. The filter has a pass-band of 0 to 32 mc., 52 ohm impedance, insertion loss of .5 db (maximum) in the pass-band range and 100 db (normal) in the stop-band range. This filter contains BNC type connectors and may be installed in the AN/URC-32 receiver antenna input line for the attenuation of input signals above 32 mc.

AN/URC-32—FACSIMILE USE

Facsimile Receive System—For reception of facsimile transmissions, the AN/URC-32 receiver output from junction-box terminals F-11, F-12, C-13, C-14 (LSB only), or C-15, C-16 (USB only) is connected through the receiver switch-board or direct to CV-172/UX (Frequency Shift Converter) and RD-92/UX or AN/UXH-2 (Facsimile Recorder).

Facsimile Transmit System—For transmission of facsimile information a scanner (TT-41B/TXC-1B), or its equivalent, is connected to a MC-168/UX modulator through the transmitter switchboard (or direct) into either the upper sideband (terminals C-1 and C-2) or lower sideband (terminals C-11 and C-12) transmitter audio input lines. In addition, a transmitter control (C-1004/SG), or its equivalent, is connected to the transmitter for keying control and control indication. The output of the MD-168/UX unit provides a frequency shift audio of constant amplitude between 1500 and 2300 c.p.s.

AN/URC-32—POWER AMPLIFIER TUBES

Additional shock tests conducted by NEL have disclosed that one factor that may be the cause of the high replacement rate of fuse F3 in the High Voltage Power Supply is the internal construction of the 4CX250 () and 7580 type tubes used in the Power Amplifier. The tube's grid is supported by two supports and under shock or severe vibration, the grid touches the cathode element. The Bureau is expediting an improved design (4CX250R) for the elimination of this condition. After further tests, procurement and stock of the improved types, availability information will be provided in the EIB.

AN/URC-32:8

During the course of production of the AN/URC-32, the Power Amplifier Tubes used were the 4X250, 4CX250B, and the 7580. Any of these tubes may be satisfactorily used in the equipment. Ships have reported difficulty in obtaining tubes. The 4CX250B type (N5960-615-4376) are reported in critical supply, the 7580 (N5960-752-5447) are reported available.

Refer to ESO Notice 4410, Serial 1008,814 of 2 March 1961.

AN/URC-32—TEST DEVICE

Component parts for fabricating the test device as shown in NAVSHIPS 93285(A), figure 4, page 4, of the Power Amplifier unit AM-2061/URT (367A-3) may be obtained from the supply system under the following stock numbers:

.01 Capacitor—N5910-678-5306 (same as part 34C1 in RF Tuner Module)

220UH Inductance—N5950-686-6425 (same as part 3A4621 in RF Tuner Module)

Diode—N5960-284-6516 (same as part 5CR2 in CS/FSK unit)

AN/URC-32—AIR FILTER

A submitted P & O report has provided the recommendation that an extra blower air filter (N4130-679-9506) be requisitioned so that the equipments' existing filter can be replaced immediately in order to keep the equipment on the air continuously. The dirty filter can then be cleaned at a more convenient time.

AN/URC-32—FIELD ENGINEER ASSISTANCE AVAILABILITY

Ships and activities experiencing equipment difficulties that cannot be resolved may request available field-engineer services from COMSERVLANT, COM-COMSERVPAC, or BUSHIPS, Code 695D1.

This service is available for limited equipment checkout, and for operational and maintenance instruction purposes upon request.

AN/URC-32—MICROPHONE AMPLIFIER MODULE

The microphone amplifier module, located within the audio and control unit (AM-2060/URC), is not normally used in the AN/ARC-32. An equipment field change is currently being prepared to remove this unit including the associated front panel microphone (MIC) receptacle, wiring, and transformer T6. Later production models of the AN/URC-32 will have this module removed and the modifications applied.

The microphone amplifier module is the same as the upper-sideband and lower-sideband line-amplifier modules contained within the same chassis and, pending further instructions, may be retained on board as a spare.

AN/URC-32—RECURRING FAILURES

Power Amplifier Nylon Gears—Caused by misalignment of dial gears. Later production units have had this problem

ORIGINAL

SERVICE NOTES

NAVSHIPS

900,000.1

COMMUNICATIONS

corrected. Field Change 1 AN/URC-32 provides new dials for the equipments earlier produced. Periodically apply lubrication to the dial plates by using the "Lubriplate" material supplied in the AN/URC-32 tool kit.

A15, Z16 RF Tuner Coils—Caused by burnout due to high-level RF feed-in from antenna. This failure will be eliminated by the use of the protective device supplied in Field Change 1 AN/URC-32 for equipments (serial no. 1 through 359). Equipments with serial numbers 360 and above have this protective device installed.

R-13 in RF Tuner—Caused by excessive drive during the tuning process or the feed-back of high level RF in the receiver-antenna transmission line. This failure should be reduced when the receiver protective device is installed. Ships experiencing this failure should attempt repair on board, if possible, rather than shipping the entire assembly to a repair activity.

Fuse F3—This failure has been attributed to several causes such as shorted power-amplifier tubes, switch arcing as reported in EIB 545, and failure of C49 in power amplifier or circuit transients. The major cause of failure is believed due to the internal structure of the power amplifier tubes which is being corrected by the design of a more rugged tube.

Rattle and Binding of Frequency-Generator Frequency-Change Mechanism—Apply lubrication periodically as speci-

fied in the Technical Manual and the Maintenance Standard Book.

RF Tuner Band-Switch Shaft Binding—Apply lubrication periodically as specified in the Technical Manual and Maintenance Standard Book. Later production units have been provided with a bearing at the end of the shaft, away from the drive motor. The lubricant is provided in the AN/URC-32 tool box.

No Shift in FSK Mode—Check diodes CR2 and CR3 (1N67A or 1N198). Failures of these diodes have been caused by installation miswiring, application of too high current, failure to install 800 ohm resistor at TT-23/SG board (or in equipments junction box), and incorrect polarity of the complete teletype system.

AN/URC-32—USE ON 50-CYCLE POWER SOURCES

Occasionally information is requested on the use of the AN/URC-32 ashore where only 50-cycle power is available. The only effect of using 50-cycle power is that the equipment's blower motor will run slower causing a reduction in the amount of air supplied to each chassis. To offset any damage to the equipment's final amplifier tubes from heat, the air ports on each of the chassis should be **closed one notch** and the final amplifier air port should be **fully** opened.

AN/URD-4 DIRECTION FINDER CABLE DISCREPANCY

Equipment, Serial Numbers 462, 463, 465, 467, 469, 470, 473, 475, and 476 may have been shipped without the required 23-inch lengths between cables W802 and W803 and their respective AN-3057-10 Cable Clamps.

If this discrepancy actually exists in the equipments, it will not immediately affect the operation of an AN/URD-4. However, when either of the two drawers, R-353/URD-4 Receiver or PP-556/URD-4 Power Supply, is opened for servicing, a chafing action may take place upon closing. To correct the discrepancy, it is necessary to loosen the screws in the AN-3057-10 and the rubber sheathed cable clamps located between TB8-1 and the fixed end of the individual cables. The cables may then be extended until the required length is obtained and then secured by tightening the loosened screws.

AN/URD-4 Antenna Simulator

An antenna simulator for use with the AN/URD-4 direction finder has been constructed. When an AN/URD-4 is removed from a ship for repair, the simulator makes unnecessary the time-consuming and expensive process of removing the antenna, provided the antenna too does not need repair.

The simulator consists of a drive motor and two-phase generator, a sense relay and a calibration tone wheel and pickup. A nominal 900-rpm motor connected directly to a two-phase generator with a 9-volt output (15 cps) will suffice to produce a circular trace on the AN/URD-4 indicator. A 72-tooth tone wheel on the motor shaft and a pickup magnet and coil, similar to those of the AN/URD-4, with its output controlled by a relay, serve to produce a calibration pattern when the SENSE-CALIBRATE switch is in the CALIBRATE position. The entire assembly can be mounted on a 14-inch x 4-inch aluminum base.

By means of the antenna simulator the procedure of Section 3, paragraph 3b, "Pattern Calibration", of NAVSHIPS-91912(A) may be followed to check indicator operation and provide initial alignment. Very little alignment is then necessary when the equipment is re-installed.

The antenna simulator therefore may be used to advantage by a shipyard, tender, or any other activity which is concerned with extensive AN/URD-4 repair and maintenance.

Tacan Performance and Operational Reports

Recent reports indicate that difficulties are being encountered in the areas of installation, maintenance, and operation of TACAN equipments and systems.

In order to assist in correcting these difficulties as rapidly as possible, it is requested that Performance and Operational Reports, NAVSHIPS 3878, be submitted on all TACAN installations. The reports should specify the model beacon and the type of antenna group being used. For example: indicate whether an OA-552/URN-3 or an OA-1545/SRN-6 is being used with and AN/URN-3. Serial numbers of all units and equipments should be reported as well as the data and information required on the report form.

AN/URD-4 ANTENNA SIMULATOR

Mr. Leonard F. Heggstrom, Shop 67, Long Beach Naval Shipyard, has constructed an antenna similar for use with the AN/URD-4 direction finder. When an AN/URD-4 is removed from a ship for repair, the simulator makes unnecessary the time-consuming and expensive process of removing the antenna, provided the antenna too does not need repair.

The simulator consists of a drive motor and two-phase generator, a sense relay and a calibration tone wheel and pickup. A nominal 900-r.p.m. motor connected directly to a two-phase generator with a 9-volt output (15 c.p.s.) will suffice to produce a circular trace on the AN/URD-4 indicator. A 72-tooth tone wheel on the motor shaft and a pickup magnet and coil, similar to those of the AN/URD-4, with its output controlled by a relay, serve to produce a calibration pattern when the "Sense-Calibrate" switch is in the "Calibrate" position. Mr. Heggstrom was able to mount the entire assembly on a 14-inch x 4-inch aluminum base.

By means of the antenna simulator the procedure of Section 3, paragraph 3b, "Pattern Calibration," of NAVSHIPS-91912(A) may be followed to check indicator operation and provide initial alignment. Very little alignment is then necessary when the equipment is re-installed.

The antenna simulator therefore may be used to advantage by a shipyard, tender, or any other activity which is concerned with extensive AN/URD-4 repair and maintenance.

RADIO-FREQUENCY MONITOR MX-1627/URN-3 INSTALLATION INFORMATION

Care should be taken in installing the rf Monitor, MX-1627/URN-3 for use with the AN/URN-3 TACAN Equipment

For best results, the Monitor should be located in the same compartment as the AN/URN-3 below decks equipment. It has been found that with proper shielding, the MX-1627/URN-3 Monitor can be located a minimum of five feet away from the AN/URN-3 receiver-transmitter group.

The Monitor Antenna AT-592/URN-3 should be located 48 to 72 inches from the vertical center line and 43.5 inches above the antenna radome base. Reference may be made to BUSHIPS drawing, RE 36D 2085, for guidance in locating this monitor antenna.

AN/URN-3, Coil L2107, Part Numbers MA675041AY and MA675042AY

The purpose of this article is to clarify the apparent use of two different part numbers for Coil L2107, used in the

speed control power amplifier of Antenna Control C-1349/URN or C-1700/URN-3.

The questionable part numbers MA675042AY and MA675041AY are Magnetic Amplifier Corporation numbers and denote the same item. Originally, Magnetic Amplifier Corporation assigned part number MA675041AY to this item, but stamped it, by mistake, MA675042AY.

ITT-Federal Division has a newly designed direct replacement for this coil, which overcomes the overheating problem the original design presented.

Holders of equipment requiring replacement coils should request these parts through the normal supply system under part number A 1054450.

AN/URN-3-EMERGENCY PARTS SUBSTITUTION

The following information is adapted from an article which appeared in the Technical Information Letter (AACS) of January 1961, and is offered for consideration by technicians concerned with the maintenance of TACAN equipments.

Transformer T-1406 in the MD-129A/GR—which is a component of the AN/GRC-27 system—can be used as an emergency replacement for transformer T-1801. This substitution requires no modifications and fulfills all requirements of paragraph 4b(3) (c), NAVSHIPS 92348(A), AN/URN-3.

NOTE: This should be considered an emergency repair in order to reduce time of the TACAN until a new T-1801 can be installed. It should be noted that T-1801 cannot be substituted for a T-1406 because of the transformer mounting differences.

AN/URN-12 UHF HOMING BEACON

The AN/URN-12 homing beacon shown here consists of a UHF transmitting system designed for remote installation and unattended operation. The antenna is a stacked array designed for service to high-altitude aircraft and radiates an identified MCW signal for air-station location and voice modulation for ground-to-aircraft communication.

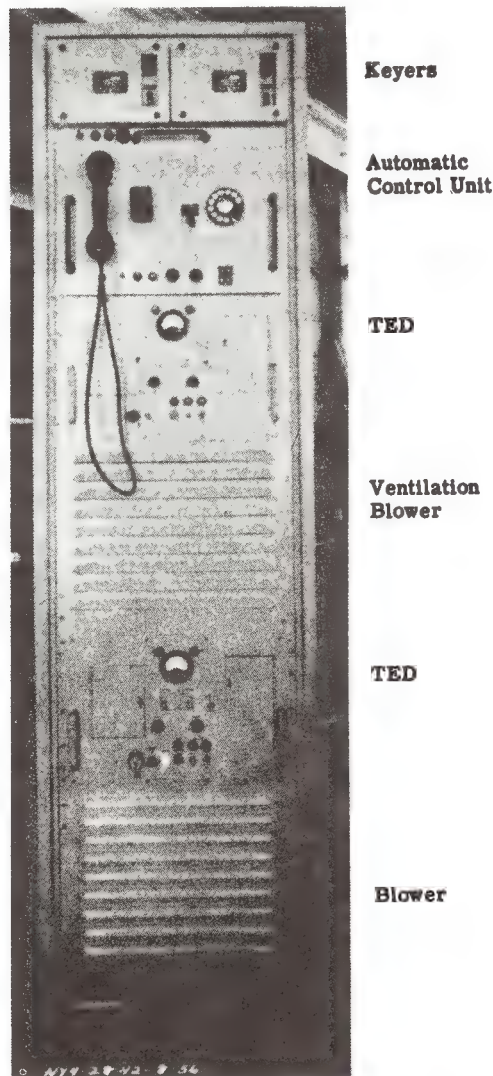
Continuous operation of the beacon is assisted by employing a standby transmitter in the system with provision for automatic transfer in event of initial transmitter failure. Improved transmitter reliability is accomplished by the introduction of heavy-duty ventilating units in the system. Indicators at both the local and remote locations are incorporated to disclose functions taking place in the system.

Control of the various functions is accomplished by a conventional telephone-dial system similar to that employed in the YA radio range. Two telephone conductors are required between the remote site and the control tower. The transmitter of the AN/URN-12 is a modified Navy model TED keyed with a Navy model KY-123/URN keyer. To increase operational reliability, the TED and KY-123/URN are provided in duplicate.

To maximize proper operation of the beacon, a monitor is provided to monitor the modulation of the detected carrier of one of the TED transmitters. In the event of loss of more than 25% of the output of the detector, the other TED is switched on; and red lights are displayed on the remote-control unit in the tower and on the transmitter rack to indicate that the alternate transmitter is in operation. Either of the TED transmitters can be made the master by switching at the transmitter rack. In addition to automatic transfer by loss of output, the transfer of TED transmitters either from master to alternate or reverse can be achieved from either operating position by means of the telephone dial system. When the alternate transmitter is in operation, no monitor protection is provided but the red lights are on, indicating an abnormal condition. The monitor does not provide protection when voice communication is in use, or when the keyer sticks causing the tone to be transmitted continuously.

In addition to the two transmitters and two keyers, the automatic--control unit and ventilating equipment are mounted in a CY-597/G cabinet, figure 1. The transmitting-site component is entirely self-contained and needs only to be connected to a suitable source of 115-volt, 60-cycle, single-phase, ac power, a telephone pair to the control-tower unit, the antenna, and ground. The tower remote-control unit contains an AM-413/G amplifier, microphone, dial

mechanism, and indicator lights. These units are now being assembled by the Philadelphia Naval Shipyard and availability dates will be published when firm.



**AN/URN-12 UHF
HOMING BEACON**

Figure 1

AVAILABILITY OF TEST CABLES FOR AN/URR-13 RECEIVERS

Test cables for AN/URR-13 Receivers procured under Contract NObsr-43176 are available in stock at SSD, ESB, NSC, Oakland, California. All activities and ships that received AN/URR-13 less test cables are advised to requisition this item through the nearest supply activity. As required, one cable for each receiver will be furnished. Receiver Serial Numbers 1 through 1281, inclusive, under NObsr-43176 are applicable.

WARNING—USE OF PROPER ALINEMENT TOOL

Attention is invited to the fact that the rf plate-inductance trimmer screws in the AN/URR-13 receiver are approximately 180 volts above ground. These screws are of the Bristol type and a special, insulated alinement tool to fit these screws is provided with each receiver.

Inexperienced or careless personnel may attempt to use a regular, metal Bristol wrench to make the plate-trimmer adjustments which would result in either a severe shock or grounding of plate voltage.

All electronics technicians are warned of this potential hazard, and are requested to insert the following warning under paragraph 4d, section 7 of the instruction book:

WARNING—Unless the Bristol-type alinement tool furnished with the equipment is used, danger to personnel and damage to equipment may result since these trimmer screws are 180 volts above ground.

REPLACING BLOWER MOTOR BEARING IN AN/URR-13 SERIES, AN/URR-27, AN/URR-35 SERIES

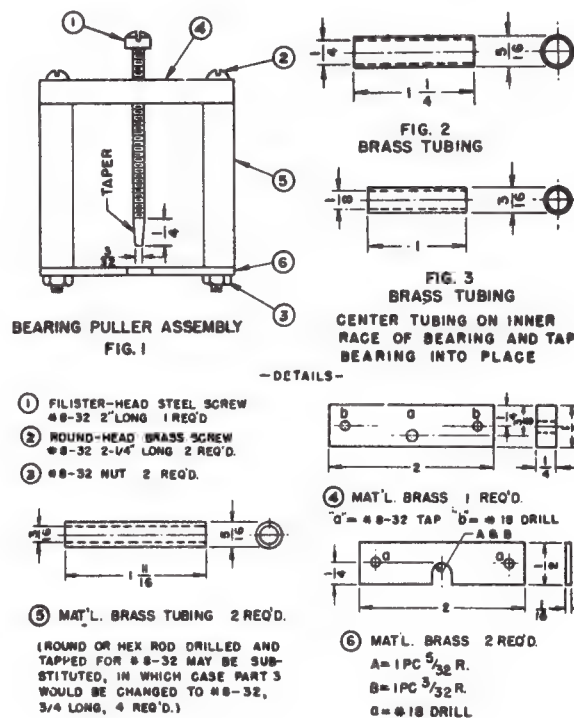
Replacement of bearing in the motor of Blower BL301 in the AN/URR-13 Series, AN/URR-27, -28 and AN/URR-35 Series is facilitated by a few simple tools which can be fabricated from scrap stock in any repair shop.

These tools consist of a bearing puller (fig. 1) and two pieces of brass tubing (figs. 2 and 3), used when driving new bearings into place on the rotor shaft. A set of these tools should be kept in every electronics shop where the above receivers are serviced.

AN/URR-13 RECEIVERS REMOVAL OF PHONE-JACK DUST COVERS

The Phone-Jack Covers, Federal Stock Number N5935-387-6548, installed on the AN/URR-13 receivers have become damaged when Phone-Jack Plug Navy-Type CN-49034A, is used with the AN/URR-13. It is noted that cause of damage is due to the phone-jack exceeding the clearance allowed in the open position of the dust cover.

The phone-jack dust covers shall be removed from the AN/URR-13 when damaged since their function does not warrant the cost of repair or replacement.



AN/URR-13 SERIES, AN/URR-27, -28 AN/URR-35 SERIES REPLACING BLOWER MOTOR BEARINGS (REVISION OF ARTICLE PUBLISHED IN EIB 396)

Replacement of bearing in the motor of Blower BL301 in the AN/URR-13 Series, AN/URR-27, -28 and AN/URR-35 Series is facilitated by a few simple tools which can be fabricated from scrap stock in any repair shop.

A puller, as illustrated in Figure 1, can be fabricated from scrap stock and will provide direct pressure on the bearing, simplifying the work and eliminating possible damage to the motor shaft.

AN/URR-13 SERIES, AN/URR-35 SERIES INPUT-METER READING

Failure of the input meter in AN/URR-13 Series and AN/URR-35 Series equipments to zero properly has been reported by several field activities. The input-meter (M501) circuit of these radio receivers includes one variable and several fixed resistors, one of which is connected between 180 volts dc and ground. This 68,000-ohm, 1/2-watt resistor has changed value in a number of cases, resulting in inability to obtain the zero indication by adjusting the variable-input balancing resistor.

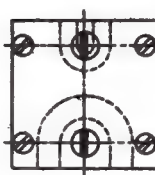
Mr. John L. Wood of the Long Beach Naval Shipyard,

has suggested that a 1-watt, 68,000-ohm resistor be substituted for the 1/2-watt resistor now provided. The Bureau approves this suggestion and recommends installation of the higher-wattage resistor when replacement of resistor R305 in the AN/URR-13 Series, or resistor R224 in the AN/URR-35 Series is necessary.

NOTE

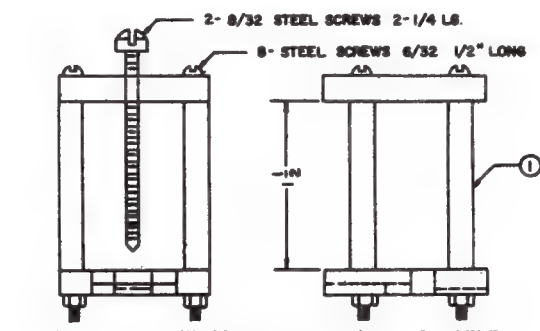
Similar difficulty in zero adjustment can be caused by a defective tube in the i-f amplifier section of the receiver. Therefore, the applicable tube (meter is connected to screen grid or plate circuit) should be checked first. No field change will be issued.

DUAL BEARING PULLER



NOTES:

- I. TOP AND BOTTOM TO BE MADE FROM 1/4" TOOL STEEL. FOUR PILLARS 1/4" BRASS ROD.
- ① DRILL AND TAP ENDS OF RODS FOR 6/32 SCREWS.
- ② DRILL 4 HOLES TO CLEAR 6/32 SCREWS.
- ③ DRILL AND TAP 6/32 SCREWS.



DETAILS

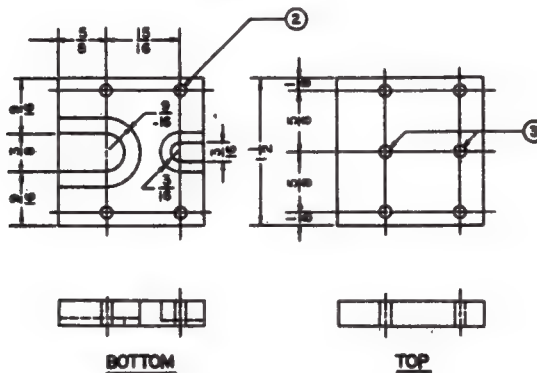


Figure 1

AN/URR-21 RCK REPLACEMENT OF ANTENNA CONNECTOR

It has been suggested that the Antenna-Input Jack J-101, Type 49120, in the AN/URR-22A and RCK (receivers) be replaced with the current standard type, UG-160C/U (SNSN N17C-73115-8494). This change conforms with the general policy of standardizing antenna-input connectors on all shipboard-communication receivers. It also permits proper termination of the outer conductor and armor on coaxial cables, thereby reducing antenna-line losses for the receivers.

Figure 1 provides details for installing a UG-160C/U and applies to the AN/URR-21A and RCK.

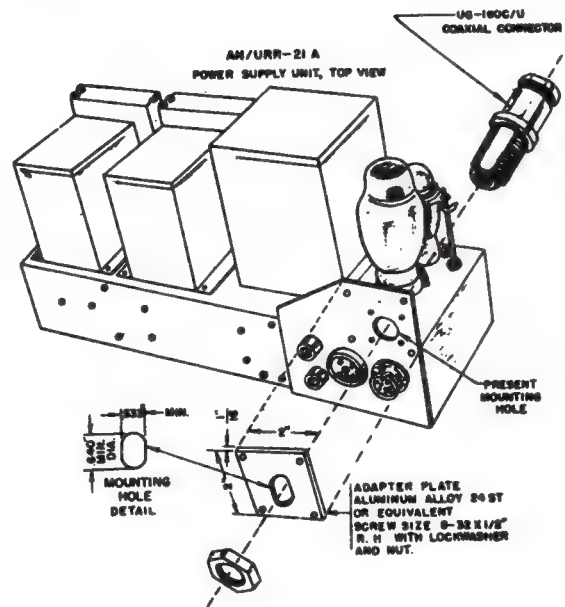


FIG. 1

AN/URR-35B MANUFACTURING DEFECT

A manufacturing defect has been discovered in Radio-Receiving Set AN/URR-35B, Serial Numbers 1 through 425. The manufacturer failed to solder the tap on the second oscillator-plate transformer T-203 before wax impregnation. Since the tap connection was made mechanically, an open circuit may never develop. However, because of failure to solder, this circuit may open in time and disable the equipment. Failure symptoms are intermittent or complete loss of signal. Since failure of all 425 of these transformers is unlikely, action has been taken to supply an additional quantity of 200 transformers, Standard Navy Stock Number N16-ET-057142-0203, for stock maintenance repair parts. If failure occurs, the transformer assembly should be replaced because, in general, it is not feasible to remove the wax and solder the tap.

AN/URR-35 SHORT PREVENTION IN RECEIVERS

A method has been found for preventing external shorts between the filament and grid of V-105. These shorts have been the cause of occasional trouble developing in AN/URR-35 receivers in the mixer of the preselector unit.

Investigation of the receivers showed that the shorts were caused by the lug on pin 6 of V-105 cutting into the wire connected between pin 9 and C-153. Symptoms of this trouble are receiver output hum, which becomes more evident when turned to crystal frequency, and low input meter indication when the receiver is in "Align" position and tuned to the crystal frequency.

This deficiency can be prevented by removing the lead between pin 9 and C-153, and replacing it with a lead of greater length. Friction between the lead and the lug of the pin will be eliminated.

AN/URT-2, -3, -4 OVERHEATING

The Bureau of Ships has received reports that Radio Transmitters AN/URT-2, AN/URT-3 and AN/URT-4 are not functioning properly because of overheating.

An investigation of this problem indicates that in a majority of cases the cabinet heaters have been inadvertently turned on instead of the crystal oven heater.

The transmitter cabinet heaters are needed only during operation under extreme cold weather conditions. The cabinet heater circuit may be disabled (on shipboard installations) by removing fuse F-3001 from the medium voltage power supply.

AN/URT-2, -3 AND -4 INSPECTION OF BRUSHES

The brushes in the Power-Amplifier Blower Motor (B-1304) require inspection after approximately 1,000 hours of operation. Unless the brushes are inspected regularly, the commutator of B-1304 will be damaged. If the blower motor fails to operate, the transmitter thermal overload will trip, rendering the transmitter inoperative.

Blower Motor B-1304 must be removed from the RFA to check the brushes. There are three mounting screws and two motor leads which must be removed before motor can be removed from the chassis.

A number of blower motors have been found in which the brushes had worn away and the motor was attempting to run on the brush spring instead of the brush. The commutator was so badly worn that the whole assembly had to be replaced.

It is recommended that field activities insure that 1000-hour brush inspection is observed as a part of preventive-maintenance routine. The filament elapsed-time meter is a convenient means for verifying 1000-hour intervals.

AN/URT-2, -3 AND -4 AN/SRT-14, -15 AND -16 CORROSION OF CABLE CONNECTORS AND RECEPTACLES

Excessive corrosion of cable connectors and receptacles on rf tuners and couplers used with AN/URT-2, -3, -4 and AN/SRT-14, -15, -16 Radio Transmitters has been reported.

Upon installation of the rf tuners and couplers, a hard-film, corrosion-preventive, petrolatum compound should be applied to all portions of the connectors and receptacles exposed to the weather. Care should be taken not to apply the compound to the inserts, pins, and sockets of the mating parts. The connector should be disassembled to the extent that the compound can also be placed on the gland housing and inside of the coupling nut.

Connectors and receptacles which are corroded should be disassembled and thoroughly cleaned. This should be done by wire brushing and then polishing. After cleaning, inspect carefully for pitting. If connector or receptable is badly pitted, a new one should be installed. If the

connector or receptable is useable, the corrosion preventive should be applied as indicated above.

Corrosion-Preventive Petrolatum, Class 1 hard film compound, stock number WM8030-244-1301, is recommended for this purpose. Although this compound normally required heating and should be applied while hot, for this purpose, it is recommended that it be applied without heating in order to get the maximum protection. If this compound is not available, Dow-Corning DC-4 should be used. Regardless of which compound is used, it should be applied liberally.

AN/URT-2, -3, -4, AND AN/SRT-14, -15 AND -16 RADIO-FREQUENCY POWER AMPLIFIER

The plate-overload alarm switch S-1381 is a radiant-heat thermal switch, not a convection-heat thermal switch. Operation of switch S-1381 is dependant on the color of the 4-400A power-amplifier tube. To check for proper operation of switch S-1381, connect the radio-frequency amplifier to the extension test cable. With transmitter AN/URT-2 and AN/SRT-14 operating at the 100-watt level, or transmitter AN/URT-3, AN/URT-4, AN/SRT-15 and AN/SRT-16 operating at the 500-watt level, observe the color of the PA tube plate when the transmitter is keyed. Normal operating color is dull red at the 100-watt level, or bright red at the 500-watt level. Alarm switch S-1381 should not operate under these conditions. If the color of the PA tube plate becomes a bright orange, then the alarm should sound, indicating excessive dissipation. The following checks should then be made:

1. Operation of PA tube blower. If blower is operating, air is forced through the PA Tube chimney. Air blast may be observed by holding hand about 6 inches above the tube chimney.

2. On the AN/URT series, check PA stagetuning by placing "Operation Selector" switch (A) in the manual tuning position and manually tuning the PA stage for maximum power output. Note whether returning corrects overheating of PA tube. If autotuning does not tune PA stage to maximum power output, overheating of PA tube will occur, and corrective maintenance of the PA autotune stage will be required.

3. Check fixed grid bias on the PA stage as follows:

- a. Connect the dc probe of Multimeter ME-25A/U, or equivalent, to the junction of L-1311 and R-1344. Place meter on the 250-volt scale and set meter-function selector to minus. The junction of L-1311 and R-1344 is accessible from the right side of the RFA, at the rear, beneath the PA tube socket.

- b. After equipment has been tuned to carrier-ready condition, disconnect the RF extension cable from P-1301 on the AN/URT series, or turn the excitation control (ZZ) to zero excitation on the AN/SRT series.

- c. At 100-watt level, adjust bias control R-1345 for a meter reading of minus 105 volts.

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

d. Repeat step "b" at 500-watt level. Adjust bias control R-1348 for a meter reading of minus 155 volts.

4. The 4-400A power amplifier tube may be defective. Change tube. If alarm switch S-1381 operates when the PA tube is only a bright red color, switch S-1381 is defective. Switch should not operate until tube plate becomes an orange color. Change switch if a replacement is available. Be careful in replacing the switch not to touch the black metal strip. To do so will effect switch operation. As an emergency where a replacement is not available, S-1381 may be adjusted by resetting the adjustment nut on the back of the switch as follows:

a. With equipment operating at maximum power output in the manual-tuning position, slowly detune the PA stage from maximum power output. Observe the color of the PA tube plate while detuning.

b. When plate becomes a bright-red color, turn adjustment nut on the thermal switch, S-1381, slowly clockwise until the alarm is cut off.

c. Detune PA stage until the PA tube plate becomes an orange color. Switch S-1381 should operate and sound alarm.

AN/URT-2, -3, -4 TRANSMITTING EQUIPMENT IMPROVED AUDIO RESPONSE

Improved audio response can be obtained from the low-level radio modulator if the 5814 tube, V-1121, is changed to a 12AT7 tube. Where improved audio response is required for proper operation, this change should be made.

audio response can be obtained from the low-level radio modulator if the 5814 tube, V-1121, is changed to a 12AT7 tube. Where improved audio response is required for proper operation, this change should be made.

MORE INFORMATION ABOUT AN/URT-2, -3, -4 TRANSMITTERS

The Electronic Supply Office has initiated action to procure and stock the gaskets used in the AN/URT transmitter-series tuning units. The availability of these gaskets (Symbol H-442 and H-444) and the stock number will appear in a later issue of the EIB.

After an investigation of the above gaskets, the Electronics Technician School, Great Lakes, discovered that by tightening the connectors and the antenna-lead-in stuffing tube in the end plates of the tuning unit, the loss of pressure was practically eliminated. The gaskets on the end plates, H-442 and H-444, were not renewed and special attention was given to the antenna stuffing tube. After a maintenance overhaul of one tuning unit, the unit was pressurized at 10 lbs. The 10-lbs pressure was maintained for several weeks without loss. Before the overhaul, the unit would lose 2-1/2 to 3-lbs pressure biweekly. The above information was forwarded to the Bureau for publication by Electronics Supply Office.

AN/URT-3, AN/URT-4 AN/SRT-15, AN/SRT-16 ABNORMAL FUSE FAILURES

Performance and operational reports on the AN/URT-3, -4 and AN/SRT-15, -16 (radio transmitters) indicate abnormal, inoperative periods. Several periods have amounted to 700 hours or more. The reports usually attribute these prolonged breakdowns to the failure of primary line Fuses F-1501, F-1502 and F-1503.

Repeated fuse failures may indicate that high voltage is arcing to ground through an air path or that incorrect fuses have been used. The following procedure will aid in locating the source of trouble.

(a) Check to see that the correct fuses are in the power supply. PP-707/URT- Fuse, Cartridge; 600V; 3.2 amps; slow-blow; Buss type FRS-3-1/10. PP-1096/SRT - Fuses, Cartridge; 600V; 3.5 amps; slow-blow Buss type FRS 3-1/2.

(b) With power off (Power Supply still connected to the transmitter), measure the resistance to ground at Terminal 2 of Choke L-1501, PP-707/URT: approx. 200,000 ohms; PP-1096/SRT: approx. 100,000 ohms.

(c) Disconnect the high-voltage power-supply drawer from the transmitter. Again measure the resistance to ground at Terminal 2 of Choke L-1501: This resistance should measure infinity for both power supplies. If the resistance measurements are correct, the trouble is probably due to arcing.

In many cases, arcing has occurred in the base structure of the 3B28 High Voltage Rectifier Tubes, V-1501 through V-1506. Since these tubes are used in a three-phase bridge circuit, arcing in one tube may, and probably will, damage the other tubes. DO NOT CHANGE one tube at a time, but replace all the tubes in this circuit before the equipment is energized.

Another possible cause of failure is high-voltage arcing from the filament terminals of the rectifier tube sockets to the chassis. If the underside of a socket is marked with carbon deposits, replace the socket. Finally, check and if necessary, redress the cabinet wiring at all high-voltage terminals. All cabinet wiring should be kept at least one inch away from the high-voltage terminals.

Based on material compiled by O. Pedersen, Fed. Elec. Corp. F.E.

AN/URT-3, -4 HIGH VOLTAGE FUSE FAILURE DUE TO 3B24 TUBE SOCKET CARBONICATION

Fiberglass washers, 5/32-inch thick, should be substituted for the 1/16-inch washers on 3B24 Tube sockets which have become carbonized and are causing high-voltage fuse failures.

BLOWER UNIT ADAPTER FOR SERVICING TED OR AN/URT-7 TYPE TRANSMITTERS

Bench servicing of TED or AN/URT-7 Type Transmitters may be simplified by fabrication and use of the

blower unit adapter shown in the accompanying sketches. The recommended material is 0.043" aluminum. It is necessary to remove the plastic impeller housing from the TED or AN/URT-7 blower unit and rotate the housing ninety degrees in order to accommodate the adapter.

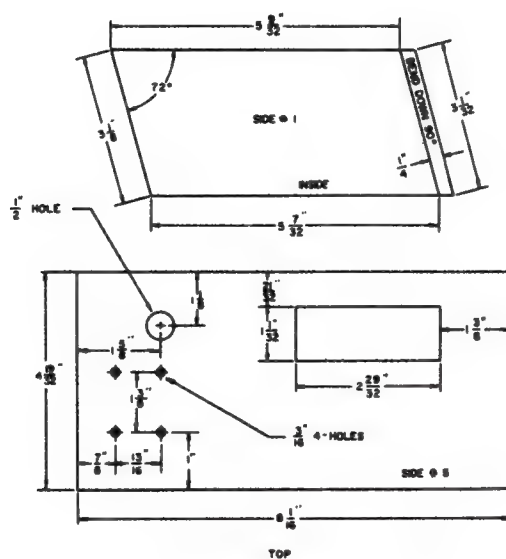
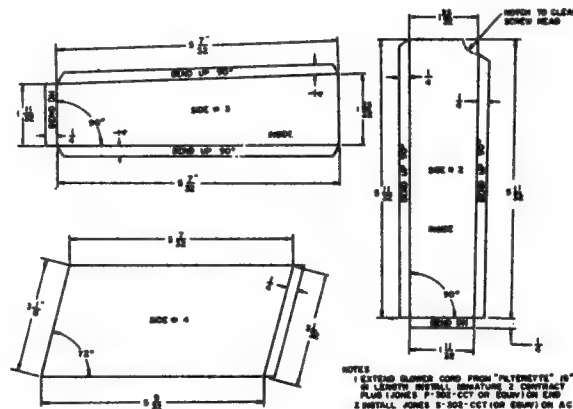
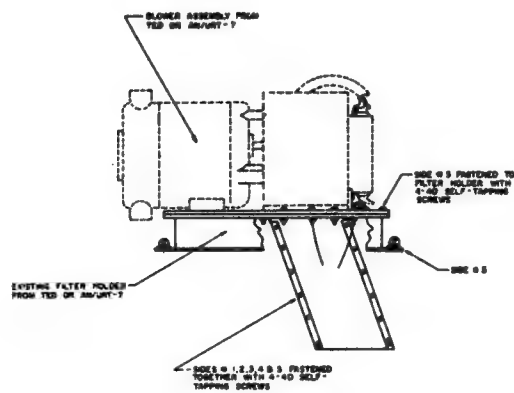


Figure 1

**RE-ACTIVATING LUBRICANT IN SEALED BEARINGS
OF SMALL MOTORS**

A method has been submitted to prevent failure of the bearings of the genemotors of the AN/VRC-2 equipment when they have been in storage for a considerable length of time.

The genemotors and many other small motors have sealed type bearings designated by the manufacturer as lubricated for the life of the motor. However, it has been found that when the AN/VRC-2 equipment is stored for some time, the lubrication may dry out or coagulate. The bearings are thus apt to fail when the equipment is placed in operation.

To prevent this trouble, the end plates are removed—thus exposing the sealed bearings to view. When faulty lubrication is observed, it is easily corrected by placing a few drops of 3 in 1 oil (or teletype light oil) on the bearings to mix with and thin the lubricant in the bearing retainer; then, following up with lubricant, in the bearing end plate during reassembly. No lubricant failures occurred after this procedure was followed.

HASH SUPPRESSION RESISTORS

The use of higher wattage hash suppression resistors (R1 and R2) in Radio Set AN/VRC-2 has been suggested. These resistors, located in the vibrator power supply, are rated ½ watt which may prove inadequate under adverse operating conditions. Poor ventilation, high humidity and prolonged transmitting periods may cause these components to fail at an abnormal rate. This is due primarily to the resistors being operated very near maximum dissipation during the receiving periods and at or slightly above this point during transmission. The use of 2-watt resistors will correct this type of failure.

Bureau Note.—While this suggestion is another good example of failure "isolation," "investigation" and "solution," it is recommended that the 2-watt resistors be used as a replacement only when the ½-watt unit fails.

AN/VRC-16, -17, -18 ANTENNAS

Attention has been called to a discrepancy between the present installation requirements for AN/VRC-16, -17, and -18, and Bureau of Ships drawing RE52F2012. (BUSHIPS drawing RE52F2012 does not show the correct type of installation. It is being revised to show the installation requirements described below and will be ready for distribution in the near future.)

Normally, each installation of these equipments consists of one radio transmitter-receiver combination, plus one additional radio receiver. Each complete installation requires two antennas. Use a pair of AT-252/SR ship antennas cut to the length specified for the frequency coverage of each equipment. One antenna serves the radio transmitter-receiver combination and the other is for the second radio receiver. This type of installation will

continue to be used until a suitable antenna multicoupler is developed permitting the use of a single antenna per installation.

Installations on submarines may deviate from shore practices. However, in such cases, the Bureau of Ships will provide instructions as to proper installation requirements.

In connection with the same equipments, Field Change No. 2, NAVSHIPS 98573, has recently been issued. (This change also applies to the AN/VRC-8, -9, and -10 equipments. The change replaces the right angle Adaptor UG-306/U and Connector Plug UG-941A/U, with right angle Radio Frequency Adaptor UG-27C/U and radio frequency Receptacle UG-58A/U. It eliminates the need for the additional Adaptor UG-349/U, and simplifies the installation. (See Field Change Distribution article in EIB 408).

AN/WRA-1 RADIO SET GROUP - MODEL DIFFERENCES

The AN/WRA-1 equipment (TBL single sideband field change kit) was manufactured by the Long Beach Naval Shipyard. The shipyard subcontracted a quantity of equipments to the Naval Repair Facility at San Diego. During the course of manufacture, a small number of design changes were made. For the information of those concerned, the following is a tabulation of model differences:

Receiver-Transmitter RT-465/WRA-1:

Units Mfgd. by Long Beach Naval Shipyard	Units Mfgd. by Naval Repair Facility, San Diego
--	---

- | | |
|--|-------------------|
| 1. Antenna input and R.F. output coax- Type UG-291/U used.
ial receptacles are type UG-58A/U. | |
| 2. Heater Power Indicator Lamp lens | Green color used. |
| 3. Fuse in B+ line to protect silicone rectifiers. | No fuse provided. |

Transmission Line Coupler CU-701/WRA-1:

- | | |
|--|-------------------------------|
| 4. Tuning meter and associated circuitry added. | No tuning meter or circuitry. |
| 5. Tube VI (amplifiers) circuit modified for tuning meter. | Not modified. |
| 6. Value of tuning condenser and coils L4 and L5 to get proper frequency spread. | Not modified. |

Of these equipment differences, items 3, 4, 5, and 6 should be applied to the equipments manufactured at San Diego. The Bureau is attempting to obtain detailed information and changes necessary so that all units will be similar. This information will be published as soon as it becomes available.

AN/WRA-1, TBL SINGLE SIDEBAND FIELD CHANGE KIT: OPERATING FREQUENCY, CRYSTAL FREQUENCY FORMULA

The AN/WRA-1 is currently being supplied for use as a field change to the Transmitter TBL series on specific ships and at specified shore facilities.

This equipment contains provisions for eight crystal controlled frequencies. For those concerned with requisitioning necessary crystals for this equipment, the following crystal formula is supplied:

- (a) For assigned frequencies in the 2 to 8 mc range, the crystal should be the assigned frequency plus 800 KC.
- (b) For assigned frequencies in the 8 to 18.1 mc range, the crystal should be the assigned frequency minus 1710 KC.

The CR-27/U type crystals are required.

AN/WRT-2 Transmitting Set; Voice Level Settings for ISB Emission

The procedure for setting voice levels of the AN/WRT-2 for ISB emission is given in Technical Manual NAVSHIPS 93319a. This procedure was based on the premise that all voice peaks will be kept within the 1000 watts peak-envelope power rating of the transmitter and the IM distortion will be held to -40db. The level of voice to develop this peak power was determined by the following:

When two or more tones of equal amplitude are combined, the probable distribution of the resultant instantaneous amplitude can be used to calculate a peak factor (PF).

The peak factor (PF) is the ratio of the instantaneous peak voltage to the r.m.s. voltage that is not exceeded some small percentage of the time. A commonly used percentage is .003 percent.

The PF for a two-tone signal is 2/1 or 6 db.

The equivalent PF for voice, although not as well defined, is generally conceded to be 16 to 20 db.

The average power output for voice transmission under these conditions would be 50 to 80 watts but the peak power would reach the 1000 watt rating of the transmitter and the -40db limit on distortion would be maintained.

Under certain operating conditions, it may be very desirable to use an average power output on voice (ISB) transmissions from 4 to 6 (110 to 300 watts average) higher than obtained with the above procedure. This would generally be true in any situation in which the radiated power

is more important than adjacent channel interference. For example, if the AN/WRT-2 were being used on a single voice channel (ISB Emission) to make a long distance contact, it would be desirable to operate at the higher average power. However, in a situation in which there is a voice channel on each sideband on a medium distance contact, it may be desirable to operate with the lower average power to minimize adjacent channel interference.

Setting the voice levels 4 to 6 db higher than the "voice" mark on the modulation level meter causes the following conditions in the transmitter:

1. The PEP increases slightly to approximately 1100 watts. Peaks above this level are flattened because of grid current in the final tubes.
2. The average power increases 4 to 6 db.
3. The intermodulation distortion increases. Measurements are difficult to make on voice transmissions, but, on similar tests on two-tone signals, the distortion products (3rd order) increase from -40 db to -20 db.
4. There is no discernible audio distortion in the received signal.

Since the PEP only rises slightly, it is safe to operate the transmitter and antenna tuner under these conditions.

In cases of extreme need, the average power on voice (ISB emission) could be increased to 500 watts average power. Intermodulation distortion will again be increased but there will be no discernible increase in audio distortion. In some cases, the maximum average power may be limited by the maximum audio that is available.

SERVICE NOTES

NAVSHIPS

900,000.1

COMMUNICATIONS

AS-390/SRC, AT-150/SRC REPAIR METHODS FOR MATCHING SECTION

NAVSHIPS 91338 states that if the matching section in the AS-390/SRC or AT-150/SRC becomes damp it should be baked out for ten hours. Apparently, it is assumed that moisture will be the usual source of trouble. This is probably true; however, there will also be times when the best repair will be the replacement of the matching section.

The following two suggested methods describe methods by which a complete overhaul of the matching unit in these antennas may be accomplished.

One suggestion proposes to drill out the insulation in the matching section by means of a hollow drill. A drill 6 1/2 inches long is used in the AS-390/SRC, and a drill 10 inches long is used in the AT-150/SRC antenna matching section. These drills are both hollow so that the center conductor of

the matching unit will not twist around the drill. After removing the center conductor, the insulation replacement is made with a length of RG-116/U cable from which the shield and armor have been removed.

The second suggestion proposes to replace the existing matching unit made up of suitable lengths of 3/8 -inch copper tubing and RG-118/U cable which has been stripped of its armor and double shield.

In both methods of repair, the matching unit must be sealed and tested for an infinity reading with a megohm meter before being reconnected to the antenna proper.

These suggestions describe two straight-forward methods of accomplishing repair of the matching unit in type AT-150/SRC and AS-390/SRC antennas. The choice of the method used depends on the facilities available and the number of antennas to be repaired. These factors will vary with the activity undertaking the repair.

ORIGINAL

AS-390/SRC:1

SECTOR ARRAY ANTENNAS AS-668/SR

The Bureau of Ships has recently received complaints about the inability to communicate ship-to-air when using Sector Array Antennas AS-668/SR and about the audible beat signal interference in the overlapping pattern areas of paired transmitters working on sector array antennas. This trouble will be eliminated if crystals having a 15-20 kc. separation are installed in these paired transmitters ensuring that the beat signal will be inaudible.

It is also well to emphasize that the practical optimum height of sector array antennas is 35 feet above waterline which will give the minimum number of lobes. It is realized that optimum height is seldom, if ever, attainable in shipboard installations but efforts should be made to approach, as nearly as possible, this optimum height.

Sector array antennas should preferably be mounted on a corner or projection although mounting on a rounded surface such as a stack or turret will give acceptable results. They should never be mounted on a flat surface since this will result in pattern distortion.

INSTALLATION OF DIPOLE ANTENNAS

The Bureau has received Beneficial Suggestions for improving the methods of fastening dipole antennas in place. These suggestions arise from the fact that personnel making the installation have difficulty aligning the mounting holes of clamps and base plates. Most suggestions involve either making a hinge type clamp in the shop (which is expensive), welding part of the clamp to the matching stub (which will probably damage the matching

stub), the use of stainless steel (which is scarce) or a combination of two or more of these procedures.

It is recommended that dipole antennas, i.e., AT-150/SRC, 66095, 66147 be fastened to the ship structure by means of "U" bolts around the yard arm of supporting bracket. These "U" bolts can be made of 1/4 inch rod which can easily be sprung enough to match the holes in the base plate of the antenna. When a plate is welded to the yard arm or support bracket the holes should be slotted enough to align with the antenna base.

AS-668/SR SECTOR ARRAY ANTENNAS

The Bureau of Ships has recently received complaints about the inability to communicate ship-to-air when using AS-668/SR Sector Array Antennas. Included have been complaints about audible beat signal interference in the overlapping pattern areas of paired transmitters working on sector array antennas. This trouble will be eliminated if crystals having a 15-20 kc. separation are installed in these paired transmitters ensuring that the beat signal will be inaudible.

It is also well to emphasize that the practical optimum height of sector array antennas is 35 feet above waterline which will give the minimum number of lobes. It is realized that optimum height is seldom, if ever, attainable in shipboard installations but efforts should be made to approach, as nearly as possible, this optimum height.

Sector array antennas should preferably be mounted on a corner or projection although mounting on a rounded surface such as a stack or turret will give acceptable results.

SERVICE NOTES**NAVSHIPS 900,000.1****COMMUNICATIONS****ANTENNA AS-768/GR MOISTURE LEAKAGE**

It has been brought to the attention of the Bureau of Ships that a source of moisture leakage in the AS-768A/GR antenna is the recessed gasket(part number MS-90133-4) of the UG-21D/U connectors supplied with the RG-8/U coaxial cable used on the antenna. There are 28 subject gaskets used in each antenna.

Replacing this gasket with gasket MS-90133-4 will alleviate the moisture leakage at this point. Action is being taken to supply the recommended gasket to all activities to which this antenna has been supplied. This change applies only to the AS-768A/GR antenna. The moisture leakage problem in the AS-768/GR and the proper solution will be disseminated when studies are completed.

ORIGINAL**AS-768/GR:1**

AT-317/BRR LOOP INSTALLATIONS ON SUBMARINES

Recent inspections of AT-317/BRR Loop installations on submarines revealed the existence of the following deficiencies:

1. Of 10 submarines inspected, three had reversed connections from the loop to the coupler.
2. One submarine had the fore-aft link open in the coupler, thus receiving on only one loop.
3. Approximately fifty percent of the subs had units installed that did not track properly. In other words, switching from one mode to another required returning the coupler.

Most of the difficulties can be avoided or corrected by closely checking the following items for conformity with the AT-317/BRR instruction book:

1. Correct polarization of leads from loop to coupler.
2. Calibration of the coupler after installation, particularly if the length of the 75-foot transmission-line cable normally supplied has been altered.

IMPROVED CABLE AND FITTINGS FOR AT-317/BRR ANTENNA SYSTEM

By means of a beneficial suggestion, the Bureau has been informed of salt water entering cable RG-160U during submerged operations. This cable is used in the installation of the AT-317/BRR loop antenna.

Recommendations to correct this default is contained in the following paragraphs. (See figure 1)

Cable: The preferred cable is RG-57A/U, FSN N6145-577-8423. An acceptable substitute is RG-57/U, FSN N6145-161-0905. (RG-57A/U has a jacket which retains flexibility at lower temperature.) Do NOT use any RG-57/U cable having a yellow, soft, waxy dielectric. Unfortunately, some of this still is in Navy stock. This dielectric is polyisobutylene and a directive to scrap all such cable was issued several years ago. It has a softening point of only 25°C and was used as a war emergency material until polyethylene was available.

Plug; cable to antenna: Make plugs locally as required in accordance with USN/USL drawing 42255B and associated details. One special O-ring is required. Both the drawing and the O-ring are available, until further notice, from U.S. Navy Underwater Sound Laboratory, New London, Connecticut, Code 1316. FSN N5330-585-1363 has been assigned to the O-ring by ESO but none are in stock yet. The use of this plug eliminates the need for making a flange or welding a hull fitting to the flange or to the antenna base. This plug will fit into the AT-317/BRR with no changes of the antenna.

Hull fitting: Make locally as required in accordance with USN/USL sketch SK-33216 and associated details, until available from Navy stock. This uses the same special O-ring as the plug; both drawings and O-ring are available from the source given above. FSN N5975-659-3063 has been assigned by ESO to the complete fitting.

Plug, cable to coupler: Procure from stock or purchase; FSN N5935-666-1406 applies. This plug is identified in several ways: UG-1060 U, Navy type 49188, Signal Corps type PL-295, or Amphenol 83-2SP.

Receptacle: The CU-352/BRR coupler must be modified by replacing the large existing receptacle with the twinax receptacle identified as UG-1057/U, NT 49196, Signal Corps type SO-265, or Amphenol 83-2R. FSN N5935-149-2856 applies.

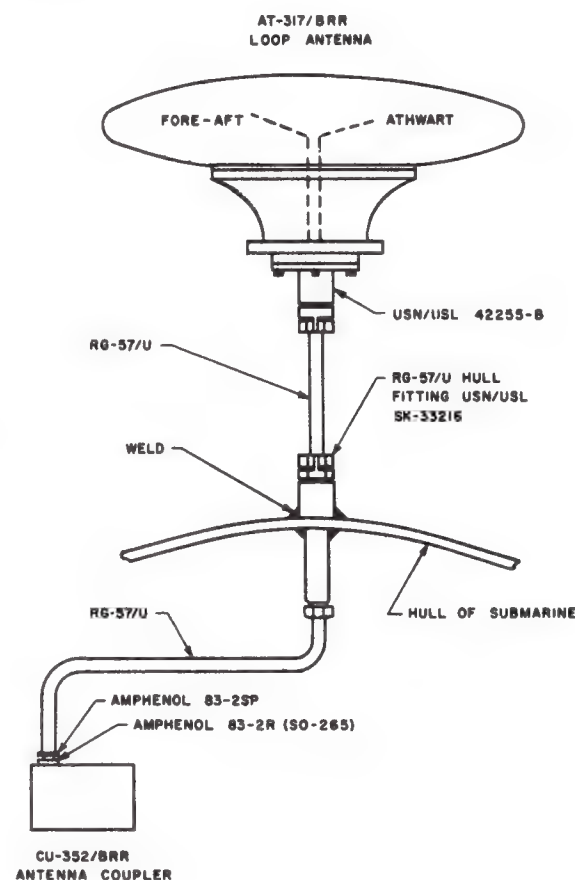


FIGURE 1

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****BA-403/U AND BA-419/U
FOR USE WITH MODIFICATION KIT MX-898/GR**

Battery BA-403/U (1.5) Volt and Battery BA-419/U (90 Volt), dry batteries, are used with Modification Kit MX-898/GR which is required for the AN/VRC-8, -9 and -10 equipments in portable applications. These dry batteries are installed in Case CY-590/GRC, and supply

voltages for operating the receiver of these equipments.

Due to the limited shelf life of dry batteries, it is recommended that the BA-403/U (FSN N6135-125-5255) and the BA-419/U (FSN N6135-125-5257) be drawn from stock only when actual use of the AN/VRC-8, -9 or -10 equipments with Modification Kit MX-898/GR is contemplated.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****FUSE MODIFICATION FOR PRIMARY PROTECTION OF
RADIO RECEIVERS (BC-348 SERIES) MODIFIED FOR AC
OPERATION**

The following modification of the AC power supply pack (EP-298) in Radio Receivers, BC-348 series, is for the purpose of providing fuse protection in the primary of the power transformer.

The installation of the AC power supply pack is shown in Figure 21—Typical Schematic Diagram Rewired for AC Operation. This marked-up diagram shows the fuse modification for primary protection.

The procedure for installing in the AC power supply pack a 1 ampere 4AG fuse is as follows:

1. Disconnect and tape the wire which connects the AVC switch moving contact to the fuse clip, at the fuse clip.
2. Move wire now connected to female receptacle contact No. 4 to fuse clip disconnected in Step 1 above.
3. Move wire now connected to female receptacle contact No. 3 to contact No. 4.
4. Insert new 1 ampere 4AG fuse in fuse clips (See Figure 1)
5. Make circuit changes in the AC power supply installation instructions schematic diagram or retain figure 1 for use with the BC-348-(Q) Technical Manual to indicate installation of the AC power supply and the fuse change to the power supply. (See Figure 1)

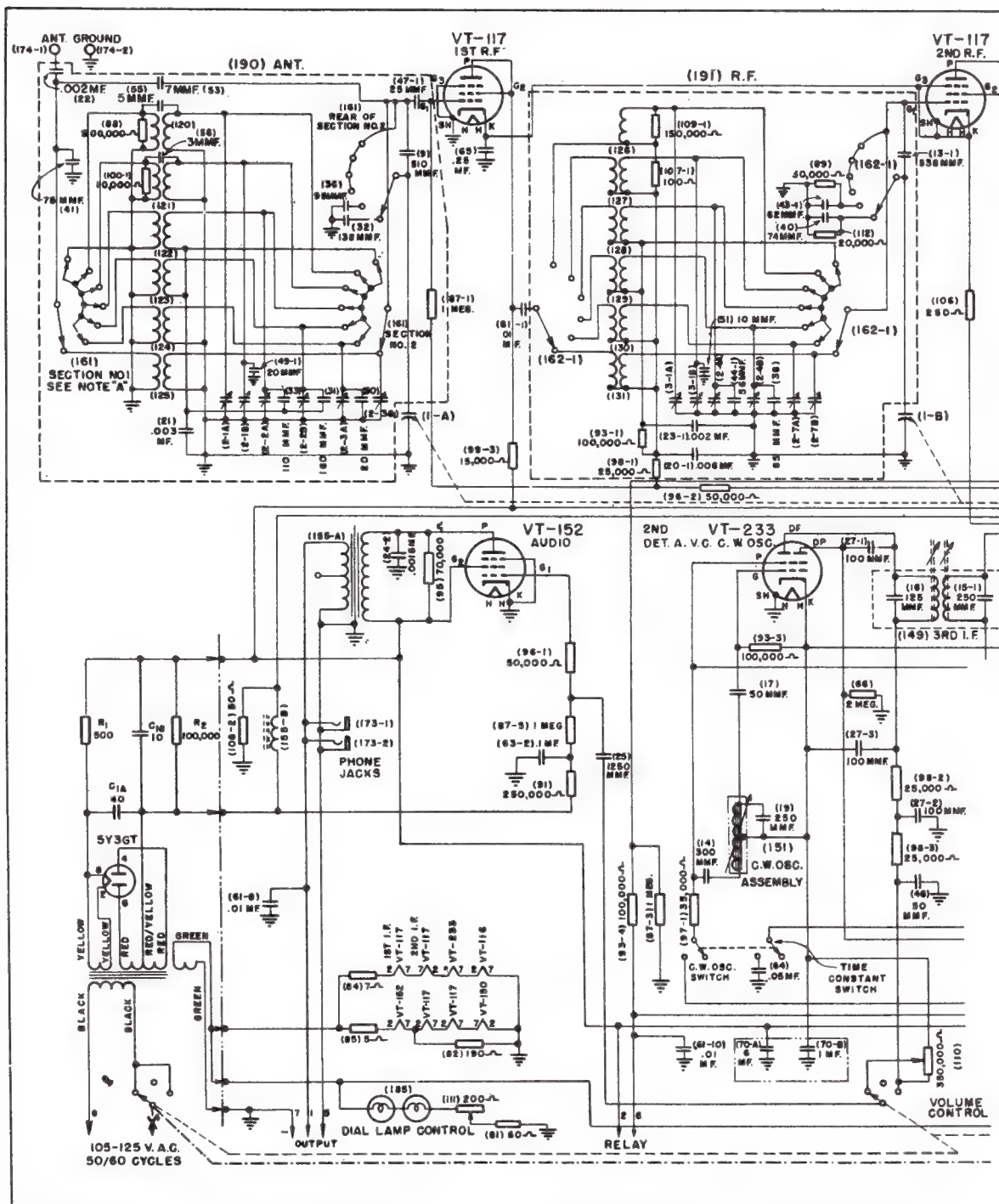
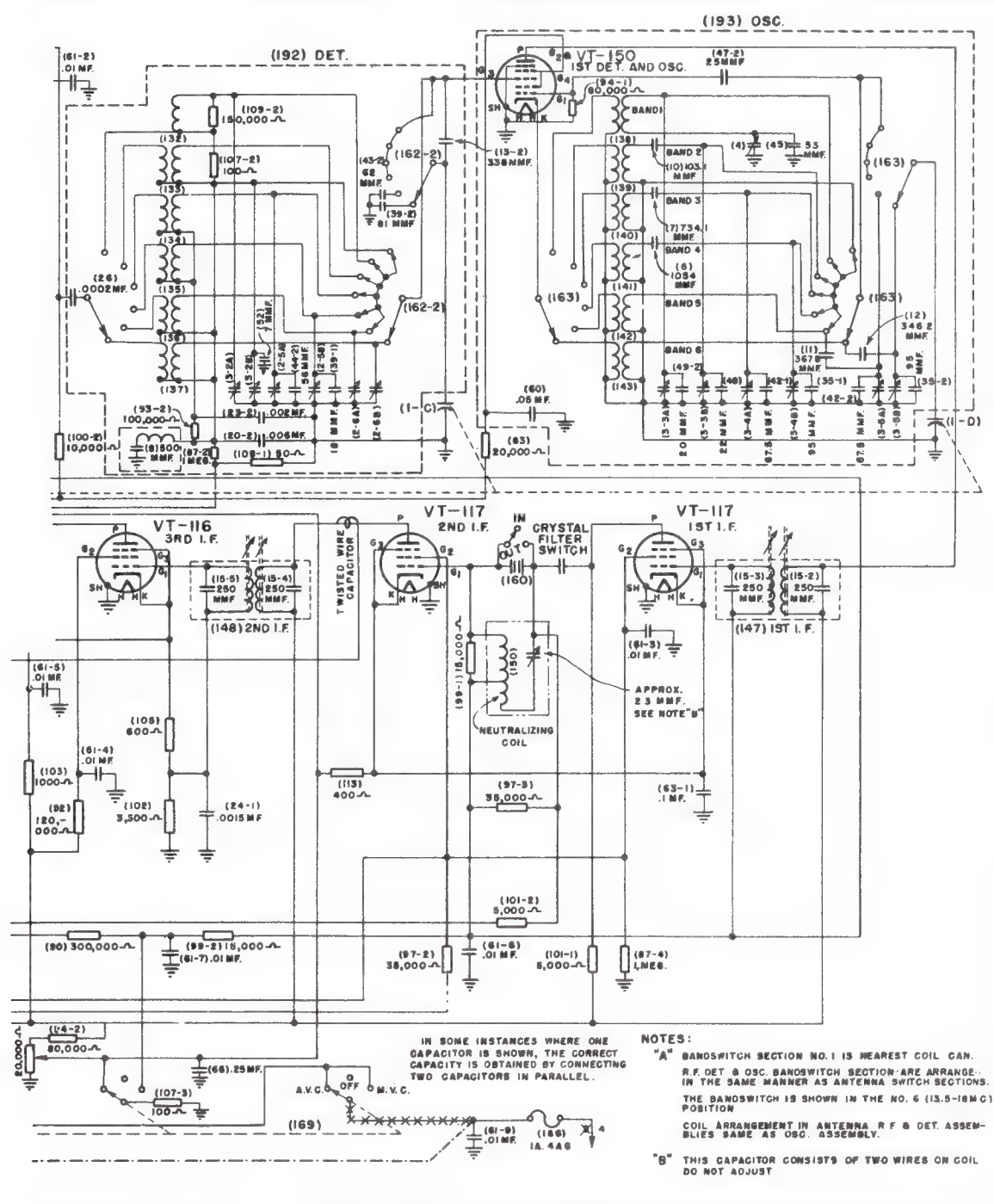


Figure 1



Typical schematic diagram rewired for a. c. operation

BC-610 TROUBLE SHOOTING NOTES

Difficulty Encountered

BC-610 (E) Overheating of transmitter during continuous operation.

BC-610.--Capacitor C-29 in transmitter fails.

Cause and Remedy

No means of ventilating interior of transmitter. Facilities for forced draft ventilation should be used or Signal Corps modification kit type MC-610 should be procured through channels. This kit includes facilities for forced draft ventilation.

Need for a higher voltage rating capacitor. A 5,000-volt capacitor was used on transmitter BC-610 beginning with BC-610 (E) serial # 5066.

MODIFICATION TO ADD NOISE LIMITER IN BC-639A

The noise limiter to be described is suggested for the purpose of reducing interference to communications. The limiter will be especially effective on interference of a pulsy nature as it operates by cutting off the audio signal for the duration of any large noise peak.

The parts required are: One 6H6 vacuum tube; two resistors of 1 megohm and 1/4 or 1/2 watt; one paper capacitor of 0.1 mfd.; one switch, SPDT; one octal tube socket; and, optionally, one potentiometer of 100,000 ohms.

The tube socket may be mounted on small metal brackets above the chassis to the rear of the audio output jacks, or may be flushmounted in a hole punched in the chassis itself. The toggle switch may be mounted anywhere desired on the front panel. If the switch is physically distant from the limiter circuit proper, it is advisable to sheath the leads running to it with Belden braid and ground the braid to the chassis by means of soldering.

Referring to the schematic diagram shown in Figure 1, operation is as follows: Rectified signal current flows through resistors 236-4 and 236-5 causing a voltage drop in the proportion to the incoming signal amplitude. The potential across 236-5 is the audio signal voltage delivered to the grid of the 6SQ7 through the limiter tube 6H6. The potential across 236-4 operates the limiter tube. Both of these voltages can vary with instantaneous changes in signal amplitude such as occurs with noise or modulation, but the cathode of the 6H6 is not allowed to follow instantaneous voltage variations across 236-4 due to the filtering action of R-1 and C-1.

These two potentials are negative with respect to the 6SQ7 cathode, point "A" being normally more negative than point "B", thereby permitting conduction in the 6H6. In the presence of a noise pulse, points "A" and "B" become more negative, and the 6H6 plate becomes more negative, but the filtering action of R-1 and C-1 holds the 6H6 cathode nearly constant; cut-off occurs because the plate is more negative than the cathode and no signal is delivered through the 6H6 to potentiometer 251 and the 6SQ7 grid.

The resistor R-2 prevents the audio output from being shorted to ground via C-1. The degree of noise-limiting

action is roughly proportional to the ratio of resistance 236-5 to that between "A" and "B" and is limited by the cutting-off of the peaks of voice modulation when this ratio is made too large.

Resistor 236-4 is shown as a variable potentiometer to permit control of the degree of noise limiting. It may be utilized without replacement with wire "A" connected to point "C".

Addition of this device to the receiver does not effect the i-f alignment provided the i-f circuit wiring is not tampered with. All parts except the 6H6, switch, R-1, R-2 and C-1 are in the original circuit. Placing the switch in the OFF position eliminates the limiter action. When used the limiter will cause considerable loss in signal strength and may, therefore, have to be turned off when used with a very weak signal.

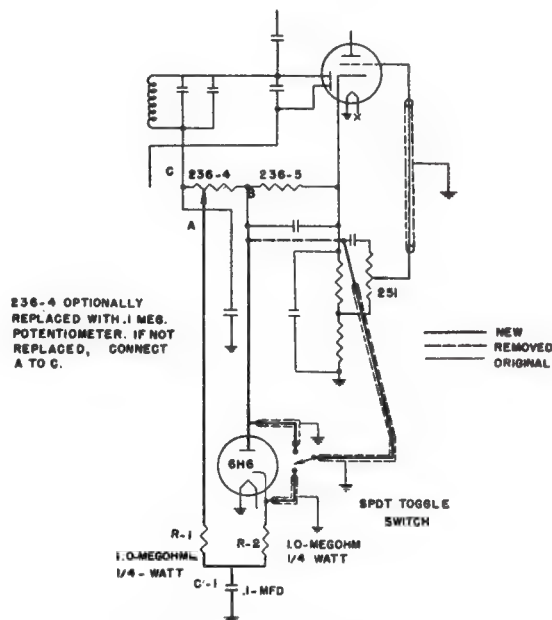


Figure 1.--Schematic diagram of noise limiter

WIRING MODIFICATION OF THE BC-640A VHF TRANSMITTER TO PERMIT REMOTE CONTROL OPERATION

In order to provide remote control operation of the BC-640-A VHF transmitters nos being installed at various Naval air activities, the following notes from a letter received by the Bureau from the Radio Material Officer, Navy Washington, are given (see Figure 1):

(1) It was decided to use two pairs for the remote control station, one pair for the audio line and one pair for the control or push-to-talk line. The remote signal line operated from relay no. 7 on PN-11-A and terminals 34 and 35 on the cabinet terminal board were not used in this installation. Therefore it was decided to make terminals 34 and 35 the remote push-to-talk circuit.

(2) On the original circuit on both REMOTE and LOCAL positions of switch 55 on PN-10-B, the plate control relay was in series with the mike, push-to-talk switch and the primary of transformer 34. Therefore for the modification. When switch 55 was placed in the LOCAL position,

the same conditions as to keying were required; namely, the transmitter would key when the local mike was out of jack 40 or would key when the push-to-talk switch was pressed on a mike plugged into jack 40.

(3) The leads from relay 7 were disconnected on the inside of PN-11-A and taped. Jumpers were placed between terminals 21 to 23 and 22 to 24 so that the laced interunit wiring need not be disturbed and spliced.

(4) The d-c keying voltage from rectifier 12 was used in both REMOTE and LOCAL conditions. For the modification all the blank blades on switch 55 were wired in so that plate control relay 8 was switched to the local push-to-talk circuit on the local mike when 55 was in the LOCAL position, and to terminals 34 and 35 on REMOTE position. By short-circuiting terminals 34 and 35, plate control relay 8 is energized.

(5) A single stage line amplifier may be required to offset the losses in a long control line in order to provide an audio level at the transmitter sufficient for 100% modulation

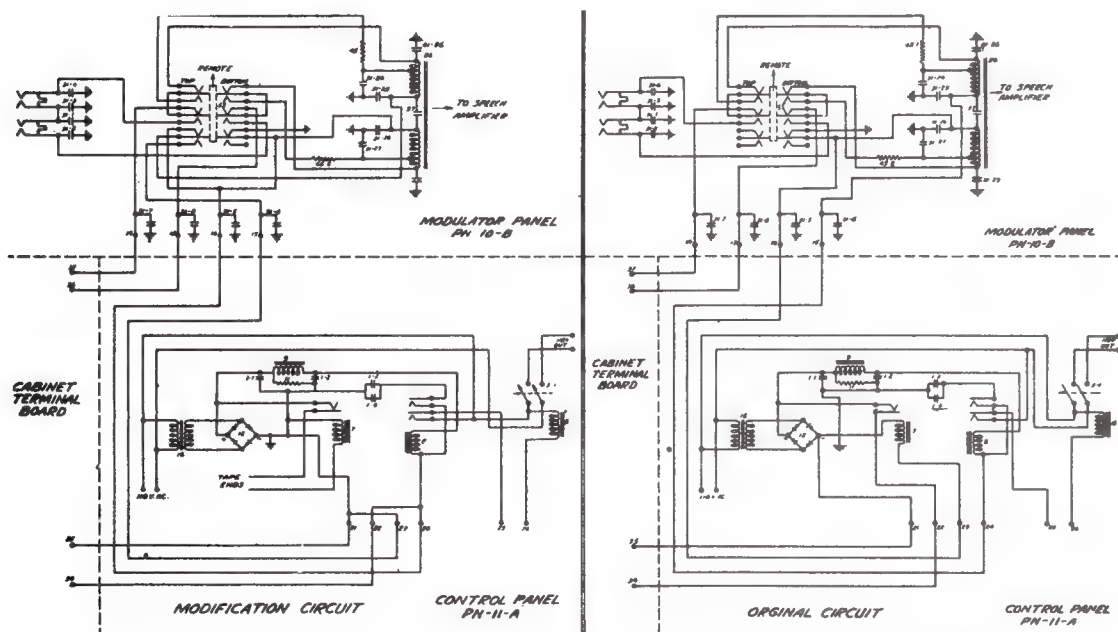


Figure 1.--Modification to allow remote control operation

BC-640 SERIES TROUBLE SHOTTING NOTES**Difficulty Encountered**

BC-640.--Equipment inoperative.

BC-640A.--Grid excitation to i-p-a dropped intermittently to subnormal values.

BC-640A.--Reports were received of weak signals from the transmitter, also that frequency of emission was 1.5 megacycles below nominal frequency.

Cause and Remedy

Rectifier tubes V-99-1 and V-99-2 burned out. Replaced and started gear--main line fuse blew. Found C-125 shorted. Replaced C-125 three times before finding a capacitor which would stand the surge. It is suggested that all capacitors in high-voltage work (over 100 volts) be checked for leakage with megger before installation in equipment.

The lugs of second tripler tank inductor, reference #181, of oscillator panel PN-9-A, were merely pressed on at the factory and the silver plating had tarnished. The lugs had never been soldered on the coil. The connections were bridged with solder and equipment now operates satisfactorily.

Checked final-amplifier tubes--all OK with balanced operation. Cleaned and removed tarnish from screw connections of linear tank, symbol 136, tightened connections, resulting in elimination of trouble.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****TAPE PULLER FOR BC-1016**

The San Francisco Naval Shipyard has suggested that an installation Recorder BC-1016 (Waters Conley Model SC-tapepuller TP-100 (DeLisser) be supplied for each shipboard installation of Recorder BC-1016 (Waters Conley Model SC-10). Re-wind facilities are necessary to place the recording tape back on the reel and prevent the tape from tearing and to ship information elsewhere for decoding.

As much as 1800 feet of tape unrolls in an hour and must be manually re-wound due to lack of a tape puller or re-winder.

As a result of this suggestion, one Tape Puller TT-2/FG is being added to all aircraft carrier Supplementary Radio Room allowances. Action has previously been taken to include a Tape Puller TT-2/FG on the allowance for cruiser installations.

ORIGINAL**BC-1016:1**

MODIFICATION OF BD-100 SWITCH BOARDS AND TYPING REPERFORATORS

This modification provides a RECEIVING-ONLY CONTROL CIRCUIT for simplex operation with the 19-type set when used in conjunction with the BD-100 switchboard. The purpose of the circuit is to shut off a reperforator while transmitting from the 19-set tape transmitter and to automatically restore it to a receiving condition when transmission ceases.

The relay and added wiring details for the modification of both a-c and d-c operated, release-magnet circuits are shown in figure 1. The details for modifying the different circuits are as follows:

(A) A-C operated release-magnet circuit:

1. Connect the foil windings of an a-c or universal type relay across terminals 38 and 42 on block B after removing strap.

2. Connect the normally-closed contacts of the relay (A and B) across terminals 30 and 40 on block A after removing strap.

(B) D-C operated release-magnet circuit.

A motor-control relay assembly part No. 72484 will be found in the left-rear corner of the motor base of the type-15 printer. This assembly is not in use so it can be wired in for this modification in either its present location or in some convenient place under the 19-set table.

The procedure for the change in the d-c circuit is as follows:

1. Contact the coil windings of the relay assembly No. 72484 across terminals 35 and 39 on block B after removing strap.

2. Connect the normally-closed contacts of the relay (A and B) across terminals 30 and 40 after the removal of the strap.

(C) Non-relay-operated reperforator.

There is a great possibility that a number of the reperforators in the field are not relay operated. It is therefore suggested that in these cases the added control relay contacts be used to short the tongue (T) and marking (M) contacts of the reperforator 255 relay instead of controlling the motor.

The modified circuit operates in the following manner: Transmission from the 19-set tape transmitter causes closure of the tape-stop switch (tape arm) and the tape-stop contact (sixth pin). This closes the magnet circuit and the control relay energizes. The contacts of the relay which are normally closed, now open. These contacts are acting as a single-pole switch in the power line to the reperforator-motor

receptacle, consequently the power to the motor is cut off and the reperforator remains unoperative. This condition is maintained until the transmission terminates and then the system returns to normal.

REMARKS

1. The current in the release-magnet circuit is ample for the operation of both the release magnet and the added control relay so it will not be necessary to make any resistance changes in this circuit.

2. Under this modification, keyboard operation of the 15 set will not cut out the reperforator. Moreover this feature is not considered to be a liability since tape tending will be the normal procedure.

BD-100 TELETYPE SWITCHBOARD

The U.S. Naval Repair Facility, San Diego, solved a perennial heat problem in the BD-100 Switchboard (wax from relay coils dripping into relays) by mounting a small "surplus" blower on the side of the BD-100 case blowing air through a 1-inch opening cut into the case. About 20, 1/4-inch holes drilled into the top of the case provided air outlet. Activities using this suggestion are requested to report to the U.S. Naval Repair Facility, San Diego.

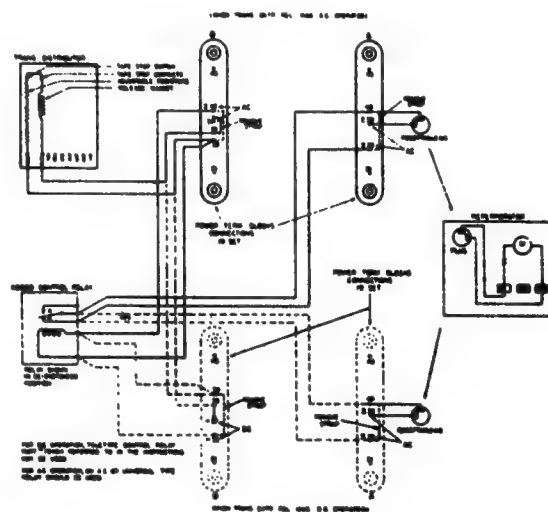


Figure 1.--Wiring details for reperforator control modification.

SERVICE NOTES

NAVSHIPS

989,888.1

COMMUNICATIONS

C-1004A/SG IMPROVED FLEXIBILITY OF OPERATION

Shorting the CFS send and tone S/R teletype circuits together, when the selector switch is in the CFS receive position, may limit the flexibility of operation of the C-1004A/SG control and associated teletypewriters.

To increase the possible combinations of patching teletypewriters and terminal equipments, the Bureau recommends that two of the fixed contacts on the rear switch be broken off to prevent the two loops from being together.

The physical location of the two fixed contacts and information for changing the schematic in the instruction book are given in figures 1 and 2.

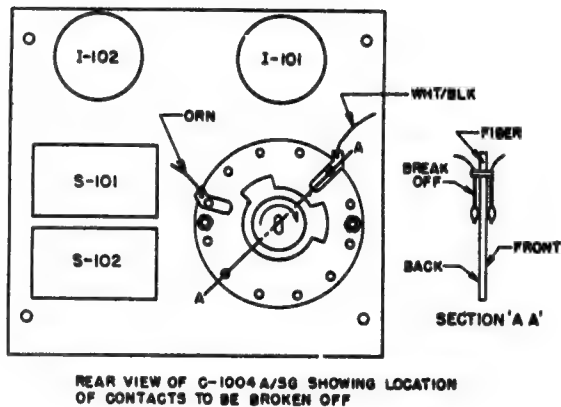


Figure 1

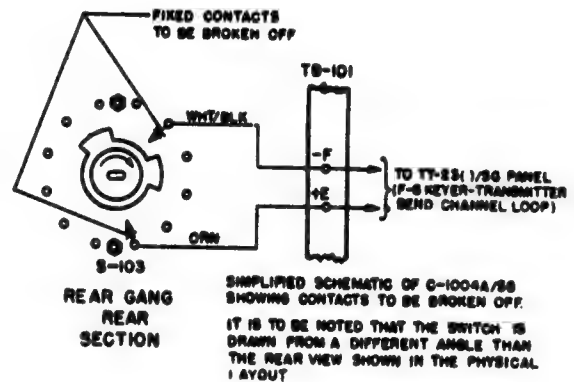


Figure 2

SERVICE NOTES**NAVYSHIPS****900,000.1****COMMUNICATIONS****AVAILABILITY OF C-1456/BRC**

A small quantity of Radio Set Controls, C-1456/BRC FSN F5840-501-1346, is available for use in submarine installations only.

Radio Set Control C-1456/BRC may be used to adapt the TCS Equipment to the Ship's 12-wire radio remote-control

system by connection through the SB-82/SRR and SB-83/SRT Switchboards. This allows operation of the TCS equipment from any one of the local operating positions or from the remote radiophone-control units.

These units should be requisitioned through the naval supply system.

ORIGINAL**C-1456/BRC:1**

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****MOUNTING OF RECTIFIER TUBE V-301 (5U4G)**

Correspondence from Naval Communication Station, Pearl, points out that the rectifier tube socket XV-301 is mounted so that the tube (5U4G) pins one (1) and four (4) are in a horizontal plane.

The specification sheet for electron tube JAN-5U4G specifies that this tube may be mounted in a horizontal position provided pins number one (1) and four (4) are in a vertical plane.

Examination of failure reports indicate the average 5U-4G tube life in the CU-168/FRR is 5774 hours, which is considered acceptable. Therefore, no formal field change to the CU-168/FRR will be promulgated. However, in the interest of lessening the failure rate of tube type 5U4G in this equipment, the tube socket may be rotated 90 degrees to re-position the pins in a vertical plane. This change requires approximately one man hour to accomplish.

ORIGINAL**CU-168/FRR:1**

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****TYPE CU-332A/UR ANTENNA COUPLER MODIFICATION**

Information received from the Material Test Branch of the Norfolk Naval Supply Center indicated unsatisfactory operation of the CU332A/UR Antenna Couplers. Tests made by the Material Test Branch revealed that the Roller-Arm Tension spring, Symbol 0-749 in NAVSHIPS 91745 (A) Figure 7-27, had become dislodged at one end of the adjustable Roller Arm, Symbol 0-751, resulting in jamming the tuning mechanism.

To correct this deficiency, the Bureau approves the method suggested by the Material Test Branch which is as follows:

1. Drill a shallow 1/8-inch diameter depression in the spring keeper flange.

CAUTION: Remove all drilling chips.

2. Connect the free end of the roller-arm tension spring to depression provided.

This small modification will prevent slippage and subsequent jamming.

ORIGINAL**CU-332A/UR:1**

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****CU-737/URC, Coupler-Monitor**

The contractor has provided additional information concerning the use of the CU-737/URC that is of general interest.

When Coupler-Monitor CU-737/URC (Collins Model 180U-2), serial numbers 1 through 136, are used with Radio Sets AN/URC-32, serials 1 through 359, that have been modified during Field Change 1-AN/SRA-22, it will be necessary to add a jumper wire between the CU-737/URC plug J8, pins 8 and 9.

It will also be necessary to provide this jumper wire in the CU-737/URC when it is used with AN/URC-32 serial 360 and subsequent serials.

The CU-737/URC, serial 137 and subsequent serials, will operate with any AN/URC-32, regardless of serial number.

NOTE: The CU-737/URC is used only in submarine installations using the AN/BRA-3, -5, and similar antenna systems; on surface ships using high frequency antenna multicoupler systems, or when a specially designed 50-ohm-antenna system is provided.

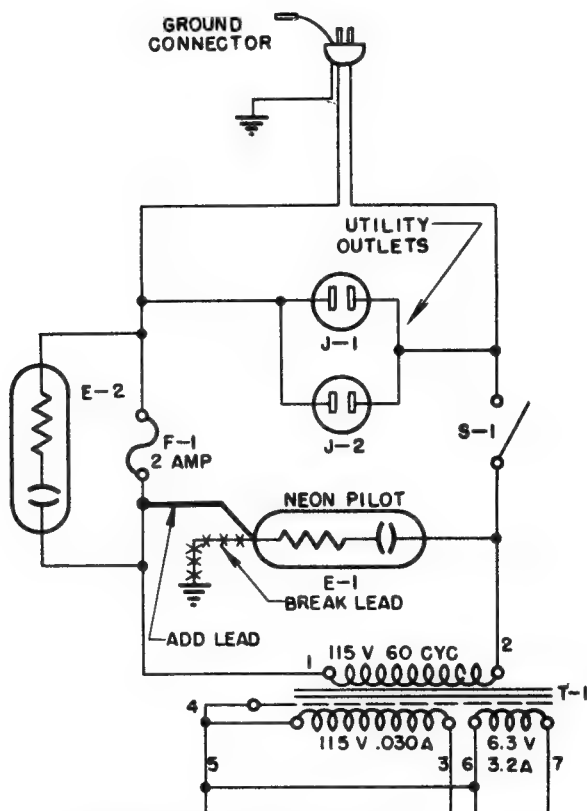
REWIRING NEON PILOT LAMP

Field activities have reported that the on-off indication of the neon pilot lamp (E1) of Frequency Shift Converter CV-172/U is not definite when the converter is operated from an ungrounded primary power input line. For this type installation, the Bureau authorizes a rewiring of lamp E1 in accordance with accompany-illustrations.

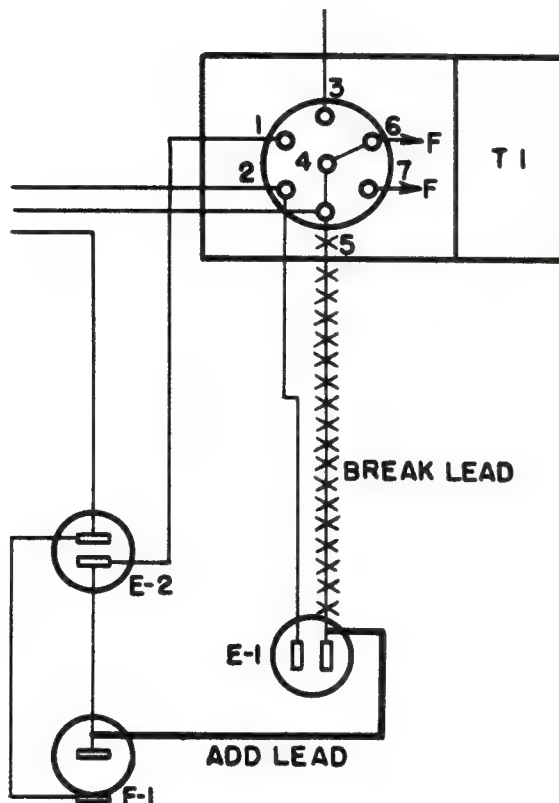
A field change will not be issued for this minor modification; however, appropriate entries to indicate rewiring of E1 should be made in the equipment history cards and instruction books.

NOTE:

These diagrams are intended as an aid in rewiring E-1. It is not a complete drawing of the CV-172/U.



CORRECTIONS TO SCHEMATIC DIAGRAM
FIG. 6 OF NAVSHIPS 91394



CORRECTIONS TO WIRING DIAGRAM
FIG. 5 OF NAVSHIPS 91394

NOTE:

These diagrams are intended as an aid in rewiring E-1. It is not a complete drawing of the CV-172/U.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****CORD ASSEMBLY CX-1846 (I)/U FOR HANDSET NT-51-007A & H-169/U**

The Bureau of Ships has been informed that Cord Assembly CX-1846/U for use with handset NT-51007A was being supplied as piece-parts for assembly at field activities. The cost of assembling the CX-1846/U greatly exceeded the cost of the completed cable assembly.

Accordingly, action has been taken to make Cord Assembly CX-1846A/U, FSN N5995-557-3654, which supersedes Cord Assembly CX-1846/U, available as a complete assembly.

ORIGINAL**CX-1846/U:1**

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****Stock Numbers for Component Parts in Handset H-169/U,
FSN N5965-679-9501**

Transistorized Type Handset H-169/U, complete with cord-assembly CX-1846A/U, is now available from stock, under FSN N5965-679-9501. This handset is used with equipments AN/URC-32 and AN/WRT-2. In many equipments, it can be used as a direct substitute for Handset Navy Type 51007A.

Component parts for Handset H-169/U are available from stock, under the following stock numbers:

Description	Part Number	FSN
Handset H-169/U, with cord assembly CX-1846A/U	RC-10385/C	N5965-679-9501
Handset H-169/U without cord assembly	RC-10385	N5965-803-4381
Earphone element	RC-10379	N5965-678-5305
Microphone unit, with retainer ring	RC-10367	N5965-678-5478
Microphone unit, without retainer ring	RC-29020	N5965-624-4134
Microphone retainer ring	RC-15014	N5965-624-4141
Cord assembly	CX-1846A/U	N5965-803-4381

ORIGINAL**H-169/U:1**

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****COLLINS KWS-1 SINGLE SIDEBAND TRANSMITTER SERVICE BULLETINS**

The Collins Radio Company recently announced the availability of two Field Service Bulletins for the Model KWS-1 Single Sideband Transmitter.

Activities having Model KWS-1 Transmitter may obtain copies of these bulletins by writing the Collins Radio Company, Field Engineering Division, Dallas 2, Texas.

ORIGINAL**KWS-1:1**

SERVICE NOTES**NAVSHIPS****900,000****COMMUNICATIONS****MODIFICATION OF FREQUENCY-SHIFT KEYS KY-43/
URT**

The frequency-shift keyer KY-43/URT is used for frequency-shift keying of the TAB-5 radio transmitting equipment, and works well in most installations. In some installations, however, the desired 170-cps shift at 100 kc. is not obtained. This is due to insufficient grid excitation of the 6SA7 tube V-801. Individual differences in keyers and transmitter oscillators are enough to cause this to happen in those equipments affected.

This difficulty was corrected at the Naval Communication Station, Annapolis, Md., by changing resistor R-811

from 1,000 to 2,400 ohms. It is to be noted, however, that this alteration also changes the frequency-dial settings of the keyer. It is necessary to recalibrate these dials for all frequencies.

Personnel at the Annapolis station also report that the fine-control potentiometer R open-circuited when set in the extreme clockwise position. This was remedied by connecting a wire between the terminals of the moving-contact arm and the lowpotential end of the potentiometer.

All KY-43/URT equipments should be checked for these troubles, and corrected if necessary.

ORIGINAL**KY-43/URT:1**

**LM SERIES
VOLTAGE COMPENSATION ADAPTOR**

The construction of an adaptor to simplify compensation adjustments of the LM Series equipment has been suggested.

Using the adaptor, compensation adjustments can be made by simply unscrewing the power supply pilot light, screwing in the adaptor and connecting the meter leads. At present, it is necessary to remove the power supply from its case and connect the meter leads across the pilot light socket. The adaptor facilitates rapid adjustment and effectively isolates the line potential present at the socket.

The following is a general guide for constructing the adapter: (actual method of fabrication will depend upon local facilities and materials.)

*Insert the rod into the base rather than recess the base into the rod.

Drill plastic block (about 2 x 2 x 2) for snug fit of 2 female receptacles (pin jacks); continue drilling through block with small drill (to pass leads to internal pin jack terminals). After drilling saw block in half so that both holes are halved (this will facilitate assembly), solder a pair of leads inside the lampbase. *Secure the lamp base to a hollow plastic rod, bringing the leads through the center of the rod. Solder the extended leads to the pin jacks and assemble the block with machine screws and nuts (make sure the screws do not hit the leads going through the block). Secure the block to the rod.

The suggested adaptor may be used at the discretion of any activity which has a LM Series equipment installed.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****MICROPHONE, CARBON, NOISE CANCELLING TYPE M-58/U**

Microphone M-58/U is now available under the Federal Stock Number N5965-655-0999. This microphone may be used where speech intelligibility is hampered by high-ambient noise and in place of Navy Type 51004C and Type M-85/U microphones. However, the microphones are not physically identical (See figure 1). Microphone M-58/U has a resistance of 100 ohms, frequency range of 300 to 4,000 cps, a 4-foot cord, and a J-068-type plug (13/64-inch diameter sleeve, ring, and tip). A lever switch, mounted on the side of the microphone, will connect the microphone in-

to the circuit when actuated. The maximum noise discrimination of this microphone is 20 db at 300 cps.

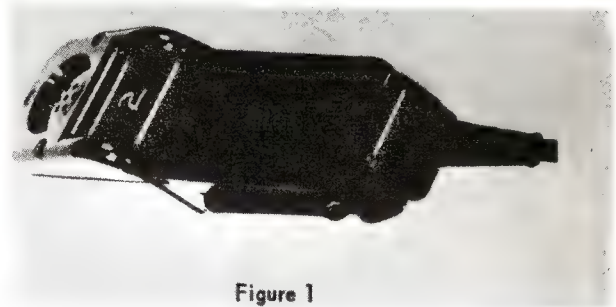


Figure 1

MAM WHIP ANTENNA MODIFICATION

The necessity for communication with aircraft 5 and 10 miles distant from the signal officer requires more radiation than is obtainable from the whip antennas furnished with MAM equipments.

Experiments indicate that by supplanting the whip antenna furnished with a type BG-56A whip, or equivalent, the needed performance is obtained without interfering with other equipments at adjacent fields.

The photograph of Figure 1 shows a close-up of the method employed in mounting a complete type MP-37 whip assembly, including the spring base employed to prevent the whip from snapping off.

The above antenna modification may be made if it is necessary to maintain communication over distances greater than was originally intended.

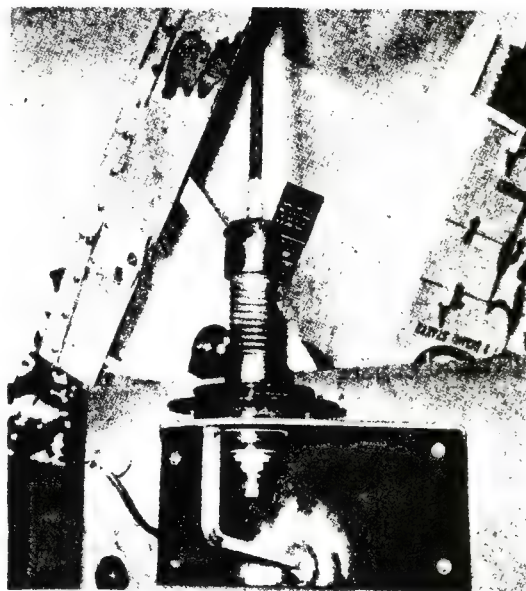


Figure 1.--Method of mounting a type MP-37 whip assembly on an MAM equipment

MAN MODIFICATION TO PERMIT OPERATION ON 115-VOLT AC

Nypearl has devised a circuit to modify the MAN radio communication equipment for 115-volt a-c operation. This is primarily an emergency measure, and necessitates the construction of a special transformer. This modification will be known as MAN Field Change No. 1. Inasmuch as this modification will not be required by all activities, a field change kit will not be procured.

The following instructions and diagrams were prepared by NYPEARL and are presented for information in the event that the modified equipment needs servicing at some other location.

A 10-wire connection box must be mounted within 3 feet of the transmitter and receiver (see fig. 1). This connection box is to splice the leads coming from the MAN equipment and the remote head if one is used. When wiring the remote, note that the numbers attached to the wires from the equipment correspond to numbers on the terminal board in the remote control head. Do not connect wire No. 1 to pin No. 1 on the plug, that is, pins on plugs do not correspond to numbers taped on wires.

The following changes are made to the transmitter vibrator power unit, as shown in figure 2:

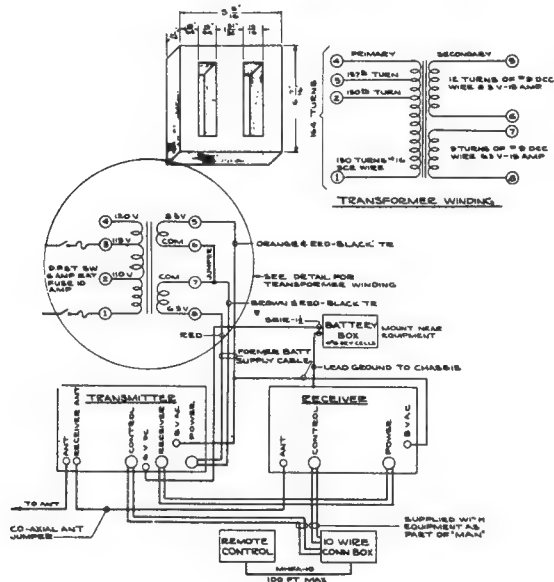


Figure 1.—Details of the transformer and interconnections needed for the modification

- (1) Remove vibrators.
- (2) Remove R₁, R₂, R₃, and R₄.
- (3) Connect jumpers from pin No. 1 to pin No. 2, and from pin No. 3 to pin No. 4 on both vibrator sockets.
- (4) Disconnect the center tap of power transformer T-1 (two solid wires in yellow spaghetti). Solder together the two wires and tape up to insulate from the chassis. This connects the two halves of the primary in series. Power transformer T-2 is modified in the same manner.

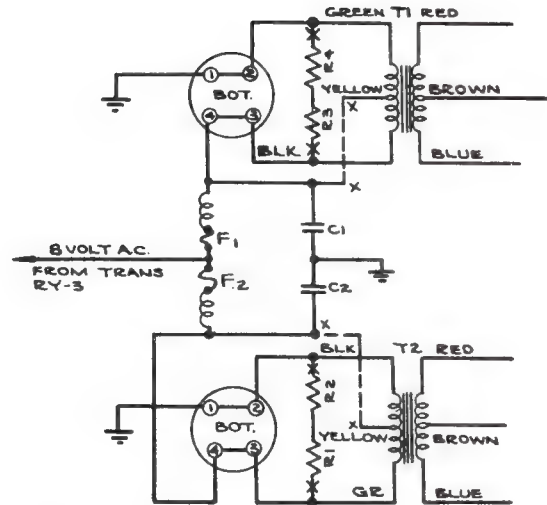


Figure 2.—FMT-25VW transmitter vibrator power unit modification

- (5) Disconnect and tape six-volt power supply lead (copper rope). Run new lead from this point to 8-volt a-c supply.

- (6) Replace 50-amp. main power fuse with a 15-amp. fuse.

- (7) Replace 20-amp. receiver fuse with a 10-amp. fuse.

The following changes are made to the receiver vibrator power unit, as shown in figure 3:

- (1) Remove vibrators.
- (2) Remove R₁ and R₂.
- (3) Disconnect and solder together center-tap leads (yellow) on primary of T₁.
- (4) Connect pins No. 1 and No. 2 on vibrator socket together.
- (5) Remove wires as indicated by dotted lines and "X."
- (6) Connect 8-volt a-c supply to F₁; remove black wire coming from transformer primary from vibrator pin No. 3, and connect it to remaining side of F₁.
- (7) Run jumper, from the junction of pin No. 1 of 6x5 socket and yellow pin connector, to pin No. 2 of power plug.

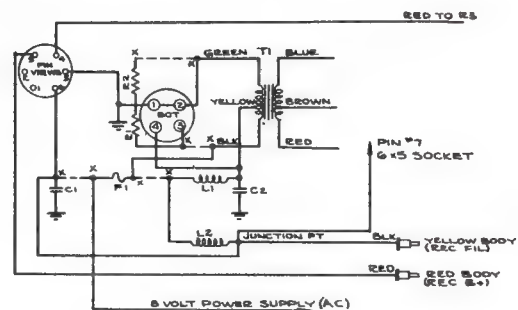


Figure 3.—FMR-13V receiver vibrator power unit modification

(8) Rec. tube 6K6 bypass condenser C-73 is changed from 0.02 to 0.002 mfd.

The following changes are made at the transmitter terminal strip, as shown in figure 4:

(1) Remove jumper between DC and 4. Connect DC to AC. Extend jumper to lug 10.

(2) Connect lug 4 to lug 2.

(3) Make up pair 24-inch leads. Connect one to lug 2, other to chassis. Connect free ends to 6-volt battery, made up of four No. 6 dry cells in series—dry cells to be placed in compartments inside equipment case.

(4) Remove jumpers between lugs DC to 3, and DC to 2.

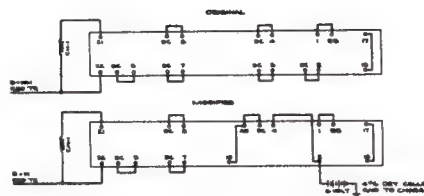


Figure 4.--Transmitter terminal strip modification

MAN SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

MAN.--Reports on transmitter output always less than the customary "Strength five, modulation good".

MAN.--Transmitter inoperative. No plate voltage. No input to the power supply.

MAN.--No power to equipment.

Cause and Remedy

One-half of the high voltage series type power supply had no output. Check revealed no input to transformer. Fuse No. 1 tested open.

Found one of the relays only partially operating. A small particle of iron filing was caught between the magnet and clapper arm.

Six-volt a-c supply from transformer not getting to receiver or transmitter. 50-amp. fuse holder found to be making poor connection. This type of holder in which the fuse is pushed into a hole from the front and a bakelite cap is screwed down, relies only upon a metal capped spring at the opposite end for a good connection. Both corrosion of the cap and aging of the spring contribute toward poor contact.

MAR RADIO EQUIPMENT PANEL METER

The scale of the meter which is mounted on the front panel of the Navy type CRV-43067 transmitter-receiver unit is calibrated in arbitrary units. The basic range of all such meters is one milliamperere and although some scales are marked "DC Milliampere" this marking should be disregarded. Some of these meter scales are marked 0- .5-1 .0, others are marked 0- 5- 10. For either calibration, the deflection referred to in the MAR Technical Manual NAVSHIPS 900,719 should be used as though the meter scale read 0-5-10.

MAR/RDR SERVICE INFORMATION MAR

(1) Field information (resetability) indicates that it is necessary to seal the grid cathode trimmers C-117 and C-118 of the tripler and power output "cans" with Glyptol or similar cement. A small amount on the end of a toothpick is a convenient method. These trimmers usually require adjustment at the high end of the band upon changing 2C39 tubes. Adjust for maximum grid drive on meter positions 9 and 11.

(2) The following meter readings are now being used by the manufacturer for final test. These readings are for OPERATE position of the IC/TEST/OPERATE switch and not for the TEST position as previously indicated. Meter limits positions 1, 2, 4, 5, 6, and 7 in RECEIVE.

Meter switch position	Tune for	Normal scale reading
1.....		5-7.
2.....	Peak ...	4.1-10.
3.....		5-7.
4.....	Dip.....	4.5-8.5.
5.....	(*).....	7.7.
6.....	(*).....	7.1 d. c. 6.8 a. c.
7.....	(*).....	6.8 a. c.
8.....	Dip.....	4.5-7.5.
9.....	Peak ...	1.0-5.5.
10.....	Dip.....	1.5-3.5.
11.....	Peak ...	4-10.
12.....	Dip.....	4.5-5.

*Plus or minus one half scale division.

(3) The MCW oscillator in the modulator unit has in some cases broken into a spurious high frequency oscillation (4000 cycles) key up on high (15 volts d. c.) line. Readjust R-725 as follows, viewed from the adjustment side:

Turn full clockwise, back off until oscillation starts (1200 cycles) key down. Continue rotation until H. F. oscillation occurs and will not stop if the key is released. Return control (R-725) about 30°. Check at low voltage (11) and readjust if necessary.

(4) The antenna compensator C-201 is now being adjusted at the factory at band No. 10 (highest frequency). Sets having this test adjustment will not require readjust-

ment of this compensator (panel adjustment) when going to any lower frequency band. This permits the equipment to be operated from the remote position at practically maximum efficiency over its whole range, and well within the limits for receiver sensitivity. The following is typical:

Channel	Ant. Adj. on No. 10 Channel UV	Ant. Adj. on each Channel UV
1	3.5	2.8
2	4.9	4.4
3	3.2	3.0
4	3.3	3.0
5	3.5	3.5
6	4.6	4.6
7	3.3	3.3
8	2.1	2.2
9	2.2	2.2
10	2.3	2.3

units (MAR) having serial numbers above approximately 1200 will have had this alignment of the RF section made in the factory. Serials above 450 (RDR) also fall in this group. It will not be advisable to attempt to realign the RF unit in the field to make the early units meet specifications with the antenna compensator left at the point of maximum sensitivity on band No. 10. All RF units that have a spot of black paint on the nut that holds the antenna compensator will have been adjusted in the latest manner. Two or three hundred additional RF units were so adjusted prior to the marking of the trimmer nut, and may appear either in spares or equipments.

(5) The screws (3) holding the dynamotor in the modulator-dynamotor unit are now being staked after being securely tightened. Units found loose in the field should be so fastened. Do not open cases specifically for this check.

(6) Check for alignment, looseness, and condition of the 2C39 tube socket connections of equipments that have seen intermittent and/or continual operation and report.

(1) The following meter readings are now being used for final test of the RDR. Filament balance has been adjusted in the factory there being no way of reading same on the panel test meter. A separate meter is placed across one-half the filament at the multiplier and R-524 adjusted for one half total filament voltage.

Meter switch position	Tune for	Normal scale reading
1		6-8.5
2	Peak ...	4.1-10
3	Dip	4.5-8.5
4		6.5-8.5
5		7.5-8.5
6		8-9
7		8-9

MAR/RDR SERVICE HINTS

The great number of cases of poor resetability has been traced directly to defects found in the 2d IPA and PA "cans." Other cases, have been traced to defects in the Selector system, Multiplier section and 1st IPA.

Before making any changes in "fixed" adjustments, carefully retune the multiplier and transmitter dials for the particular frequency in question. Make **final rotation of each selector dial in the counter-clockwise direction**. Check for normal output. If poor resetability still persists carefully retune each stage to determine which is responsible for the change in power output.

A. 2nd IPA and PA Failures--Check following:

1. Loose interelectrode capacity compensating condensers (C-117, C-118, C-112, C-120).
2. Intermittent contact of ground brushes on tuning condenser shafts.
3. Loose rotor set screws.
4. Inspect bakelite coupling shafts for cracks, splits or set screw grooving.
5. End play in rotor shaft.
6. Improper mechanical alignment of cans. (Rotor shaft of can and bakelite shaft from universal coupling must be in perfect alignment without mechanical strain. This is extremely critical.)
7. Loose set screws in tuning rotors and shaft couplings.

8. Loose 2C39 tube clamp.

B. Selector system failure--Check following:

1. Dial readings--approximately same readings between all dials except ant. coupling.
2. Individual dials should return to exactly the same reading upon reselection.
3. Check dials manually for even the slightest movement (dials should be locked).
4. Check for "overshoot" on return travel of selectors (excessive motor speed by high voltage).
5. Check recessed dials for binding on panel.
6. Check latches that are touching rim for firm locking. (Clearance between latch and rim should be approximately 1/16" with selector locked.)

C. Multiplier failure--Check following:

1. Loose tube clamp (vibration causing intermittent grounding of shield). Effects particularly notice on higher channels.

2. Loose slug trimmers (bad retaining clips).
3. Loose capacitor trimmers.

D. Miscellaneous--If 1st IPA is at fault check:

1. Gear mesh in 829 tuning.
2. Loose connections in link couplings.

Low Power Output

Trouble usually can be readily isolated and found by the equipment meter indications. The following are some of the possible causes for low output.

A. Filament balance:

Meter position		Meter reading
5.....	DC.....	7.7
6.....	DC.....	7.1
6.....	AC.....	6.8
7.....	AC.....	6.8

1. Balance potentiometer R-722 should be connected and set so balance should be within $\pm$ one-half division. The closer the better. R-720 (panel adjustment) filament control should be set to the above figures. Do not allow filament voltage to get too high or tube life will be seriously affected.

2. Check for low or burned out tubes especially 2C39's.

3. Check for shorted or low resistance "flower" -2C39 socket.

B. Multiplier section:

Meter position		Meter reading
1.....		5-7.
2.....		4.1 min. Receive.
2.....		4.8 min. Transmit.

1. Open choke-L-510-24 ohms d. c.

2. Weak or out-of-tune fixed oscillator V505.

3. Check converter stage V501 alignment.

4. Check alignment on low and high frequency ends of range. Readjust "C" on high, and "L" on low ends respectively.

5. Weak tubes or incorrect voltages.

C. 1st IPA Stage (829):

Meter position		Meter reading
8.....		4.5-7.5

1. Substitute 829 tube.

2. Check stage alignment.

3. Check operational voltage and current.

4. Check grid current for minimum 4.0 mills on all channels. (No meter position provided, reading is obtained by lifting one end of R-101.)

D. 2d IPA stage:

Meter position		Meter reading
9.....		1.0-5.5
10.....		1.5-10.0

1. Substitute 2C39 tube.

2. Check coupling of L-105.

3. Check over-all electrical alignment (with wand).

E. P.A. stage:

Meter position		Meter reading
11.....		4-9
12.....		4.5-5

F. Coaxial line:

1. Check K-101, antenna change over relay, for poor connection.

2. Check all coaxial lines and plug connections for opens and shorts.

Intermittent Power Output

- A. Poor RF ground where shield is grounded at L-105.
- B. Check for cracked Copalene permitting a short to the cable braid at L-105.
- C. Loose tube clamp on converter tube (V-501).
- D. Intermittent shorts in 2C39 tubes.
- E. Defective rotary joint at antenna coupling loop on PA can.
- F. Check all equipment connecting cables.

Low Output--Low End of Band Normal Output--High End

- A. Check Multiplier.
 - 1. Improper tracking--Align C for high end, L for low end.
 - B. Check 2d IPA and PA.
 - 1. Improper tracking.
- No compensation provided except knifing of variable condenser plates.

Normal Output--Low End of Band Low Output--High End

- A. Check multiplier:
 - 1. Improper tracking--Align.
 - 2. Loose tube clamp (V-501) (critical high end).
- B. Check 2d IPA and PA:
 - 1. Improper tracking--Align.
 - 2. Interelectrode capacity compensators (C-117 and C-118) critical at high end. (2/1/47)

MAR V-H-F RADIO TRANSMITTING AND RECEIVING EQUIPMENT**Notes on Component Failures**

A MAR V-H-F transmitting and receiving equipment for installation by ship's force has been issued. Before the equipment was placed in operation, several causes of possible subsequent failure were located and corrected. These are listed below with the idea that they may be of benefit to other installation personnel:

- (1) One end of resistor R-914 on the mounting platform touched the chassis, causing a ground in the universal power supply.
- (2) The lead connecting terminal 10 of K-901 and terminal 4 of L-901 showed 500 ohms resistance to ground when the lead was disconnected from both the relay and choke.
- (3) Capacitors C-801 and C-811 in the modulator unit were breaking down within 15 minutes after the power was turned on, causing failure of F-907 in the universal power supply.
- (4) The outside case of L-915 touched terminals 1 and 2 of L-901, causing a ground in the universal power supply.

Electronics personnel of all ships and installation activities are again reminded to make out failure report cards for every electronic failure. These forms are proving invaluable for the preparation of the new lists of spare

component parts, the design of new equipments and components, and the dissemination of maintenance information.

SHORTING OF CRYSTAL CONTACTS IN MAR EQUIPMENT

Severe field usage of MAR equipments may result in the shorting of the contacts of the five transmitting and receiving crystals to the end plates of the respective turret tuners.

This condition may be overcome by cementing a strip of fungi resistant insulating material on the bare metal end plates of the turret tuner closest to the crystal contacts. This applies to the wiring side of the chassis and is applicable to the five transmitter and five receiver crystals located there.

The insulator strip should be approximately $2\frac{3}{4}$ inches long, 1 inch wide and not over $1/32$ inch in thickness and should be applied with a good heat resistant cement.

MARKING OF DIAL LOCK MECHANISM

A simple method of marking the locking bars on the controls of MAR/RDR equipment to indicate a locked or unlocked condition has been suggested.

The MAR and RDR equipments have ten preset channels automatically tuned. These channels are preset by six controls on the MAR and two controls on the RDR equipment. These controls have to be unlocked and tuned, then re-locked before shifting channels. It is impossible to distinguish between the locked and unlocked condition of a dial by looking at it. The only way to determine if all the dials are locked is to try each one individually. Tuning this equipment requires considerable time and care. If one dial is left unlocked and the equipment is channelled automatically, mistuning will result. All of the controls must then be rechecked to determine which control is unlocked.

This trouble is eliminated by painting, in red, the exposed area of the locking bar in its unlocked position thereby quickly indicating an unlocked condition of the dial.

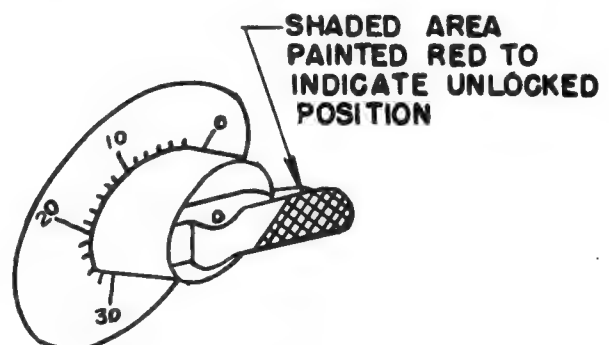


FIGURE 1. Method of marking locking bar.

COMMUNICATIONS

NAYSHIPS

900,000.1

SERVICE NOTES

MAR SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

MAR.--Very little grid drive to the intermediate power amplifier V-102.

Cause and Remedy

Coil L-105 coupled too tight to coil L-107. Spread coil L-105 away from coil L-107 to reduce the coupling. Retune transmitter.

MAR:4

ORIGINAL

HALYARD TYPE ANTENNAS OF MBF EQUIPMENTS

MBF equipments have been shipped by Collins Radio Company. These equipments contained halyard antennas and 75 feet of RG-8/U transmission line, consisting of 1 section of 50 feet and 1 section of 25 feet. The antennas, however, as determined by NRL tests, did not have the necessary broad-band characteristics. In order to tune the MBF transmitter to the antenna at the frequency of operation (in the frequency range of 60 mc. to 80 mc.) it may therefore be necessary to prune the transmission line, 3 inches at a time, until the transmitter loads properly. Collins Radio Company intends to replace these antennas later with halyard antennas of a satisfactory design.

The Magnavox Company is manufacturing antennas for permanent shipboard installation, to be used with the MBF equipment. The antennas are broad-band and the MBF will tune and load properly with these antennas without adjustment of transmission line length. These antennas (Navy type CMX-66143) will be shipped as soon as they become available.

HANDSETS FOR MBF RADIO EQUIPMENTS

One Navy type-51064 hand telephone assembly (handset) is furnished with each MBF transmitter-receiver at the time of original issue. These handsets contain the Navy standard five-wire (green) circuit and have a 20-foot cord. These handsets are not stocked, nor intended to be stocked, as separate items and therefore, are not and will not be available for replacement purposes.

For replacement purposes, the Navy standard shipboard handset type 51081, with a 4-foot cord attached, is stocked and supplied. This handset is described further in RIB No. 103.

In exceptional cases wherein the 4-foot cord of the type 51081 handset is insufficient, the short cord can be replaced with the proper length of standard handset cable, type MMPO-5. This cable is stocked at all electronic supply activities.

DEFICIENCIES OF MBF RADIO TRANSMITTING-RECEIVING EQUIPMENT

Some deficiencies of MBF equipment and the modifications required to correct these deficiencies are listed below for information of the field activities concerned. There are no kits furnished with any of these modifications.

(1) **Inadequate shockmounts.**--If it is determined that the shockmounts are not adequate for the particular installation, the shockmount supports should be replaced with supports of number 19 gauge stainless steel having adequate strength. This modification applies only to equipments with serial numbers 1 to 1824 inclusive.

(2) **Lack of intelligibility.**--This deficiency relates to a lack of intelligibility in using the loudspeaker as a microphone. To reduce the low frequency response of the audio amplifying system in the transmitting equipment and

thus improve the intelligibility, the audio coupling condenser C-119 should be changed from 0.01 mf to 0.002 mf. This change applies only to equipments with serial numbers 1 to 1536 inclusive.

(3) **Modulation limiter ineffective.**--If it is found that the modulation limiter consisting of vacuum tube V-121 (6C4) and associated components (refer to Figure 7-1A of final instruction book) is ineffective and/or does not perform its function as required, it should be eliminated (Refer to Figure 7-1B or 7-1C of the final instruction book for proper circuit connections--Figure 7-1A shows the modulator limiter included in the equipment; Figure 7-1B or 7-1C shows the proper circuit connections after the modulator limiter has been eliminated). The modulator limiter was deleted beginning with equipment serial number 480.

(4) **Excessive hum.**--The excessive hum in the equipment can be minimized by inserting an R-C network consisting of a resistor (100,000 ohms) and two capacitors (0.1 mf each) in the plate circuit of the first audio amplifier stage. (Refer to Figure 7-1B or 7-1C of the final instruction book and make circuit connections as shown; the R-C network, as shown, consists of R-157, C-122-B, and C-122-C. Do not use these symbols unless the modulator limiter is eliminated. Note that capacitors C-122-B and C-122-C are parts of capacitor C-122 (Refer to parts list of final instruction book) and may be used in the R-C network providing the modulator limiter is eliminated). This modification is applicable only to equipments with serial numbers 1 to 479 inclusive.

(5) **Squelch sensitivity inadequate.**--The squelch sensitivity can be improved by changing the audio amplifier grid resistor R-154 from 100,000 ohms to 270,000 ohms. This change applies only to equipments with serial numbers 1 to 1536 inclusive.

(6) **"Speaker on-off" markings inaccurate.**--The speaker on-off switch does not silence the speaker when in the OFF position. This deficiency came about because of a revised control circuit for the speaker talk circuit. It was corrected beginning with equipment serial number 1537. To correct this deficiency in equipments prior to 1537, the markings should be rectified to indicate the functions performed by the switch (See "NOTE" paragraph 2 (d), section 2 of final instruction book) or, if deemed more desirable, the speaker circuits should be modified as shown in figure 7-1C of final instruction book (for the proper components used in the circuit modifications refer to the parts list of the final instruction book).

(7) **Excessive output in handset.**--This condition can be remedied by increasing the resistance of the receiver audio output limiting resistor R-107 (Individual judgment should be exercised in this modification).

(8) **Antenna pick-up loop likely to short to the power amplifier tank circuit or to ground.**--Under some conditions the antenna pick-up loop shorts to the final amplifier tank circuit or to ground. To remedy this situation, an insulating sleeve should be placed over the pick-up loop and the leads connecting to it. This modification is necessary only in the equipments with serial numbers 1 to 700 inclusive.

(9) **Light from tubes shows around speaker.**--If any light from the tubes is showing around the speaker and if this light proves objectionable, the speaker screen may be eliminated to alleviate this condition.

(10) **Plug-in electrolytics not easily removed.**--This deficiency can be corrected by replacing the present electrolytic hold-in clamps with clamps of a different type and design (individual judgment should be exercised as to what types of clamps should be employed to effect the results desired). This deficiency was corrected beginning with equipment serial number 800 by a change in design of the electrolytic hold-in clamps.

(11) **Present alignment screw driver detunes circuits.**--The alignment screw driver supplied with the equipment will, under some conditions, detune the circuits as the necessary adjustments are made to the equipment. To prevent this from happening, an insulated screw driver should be employed instead of the one supplied with the equipment.

(12) **Corrections in final instruction book.**--

(a) Page 2-6, paragraph 2 (d), NOTE, second line:--Change "700" to "1536".

(b) Page 6-4, parts list, power input lead by-pass capacitor C-157:--The rating of this capacitor should be 0.002 mf instead of 0.001 mf as shown.

EXCESSIVE RECEIVER RADIATION IN THE MBF RADIO EQUIPMENT

Field activities employing MBF equipments having serial numbers below 1537 might experience excessive receiver radiation when the tuning meter and the power cable are plugged in. This excessive radiation can be reduced by providing the tuning meter circuits and the input power circuits with appropriate filters. The filter for the tuning meter circuits should consist of a choke coil of 2.7 micro-henrys and two capacitors of 0.002 micro-farads each; the filter for the input power circuits should consist of two capacitors of 0.002 micro-farads each. For proper connections of the filters refer to figure 7-1c of the final instruction book. (Note that the tuning meter-filter components are identified as L-127, C-177, and C-180 and the power cable filter components are identified as C-157 and C-175. These same symbol designations should be employed if the above modifications are made.) For pertinent data on the filter components refer to the parts list of the final instruction book. Winding data for the choke coil (L-127) is given in table on figure 1.

Part name: R. F. Choke Approx. wt. ----- Number: 240 0012 00

Type: -----

Description: Radio Frequency Choke in accordance with Navy requirements.

Inductance: 2.7 microhenrys approx. Associated data: JAN-P-14 AN-QQ-S-91.

Max. Current: 300 ma.

Coil Form: 0.170" dia. x $\frac{1}{8}$ " long with molded-in leads, Speer Resistor Corp. No. CF .170 x $\frac{1}{8}$ " or equivalent. Phenolic material shall be Type MTS-E-2 in accordance with Joint Army-Navy Spec. JAN-P-14.

Leads: Hot tin dipped.

Wire: No. 30 AWG Enameled. Copper.

Number of Turns: 45 plus 0 minus 3 turns.

NOTES: 1. Materials entering into the construction of this choke shall be fungi resistant, or the choke shall be treated to render it fungi resistant.

2. The choke shall withstand a 100-hour salt-spray test in accordance with Army-Navy Aeronautical Specification AN-QQ-S-91 without impairing its operation, and no part shall show evidence of approaching failure caused by corrosion.

3. Samples must be approved by Collins Radio Co. Engineering Department.

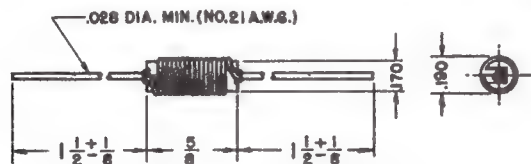


FIGURE 1.--Choke coil dimensions.

Figure 1.--Choke coil dimensions

ALTERNATE METHOD FOR TUNING THE MBF TRANSMITTER

An alternate method may be used in tuning the MBF transmitter in addition to that outlined in the MBF instruction book, section II, paragraphs 2 (e) to 1 (t) and in the

brief directions stenciled on the tuning control cover plates. With meter switch set on 6-7-8, tune # 6 for maximum drive. If meter reads backwards, leave #6 at its approximate setting and tune #7 and #8 for maximum. Stages #6, #7, and #8 should then be tuned in that order for maximum in accordance with the instruction book. In the final

SERVICE NOTES

NAYSHIPS

900,000.1

COMMUNICATIONS

stage of tuning, adjustments made to controls #9 and #11 can be accurately determined with the meter in the output r-f circuit. A state of maximum r-f absorption will occur at a point slightly below the red area on the meter scale. Maximum absorption can be determined using a pen lamp with a pick-up coil placed inside the final tank coil.

passes under C-126 (tuning control #4). Occasionally the shield on the coaxial cable grounds out C-126 thus preventing the tuning of the r-f amplifier V-108. All ships and stations using MBF equipment are urged to check their gear for this defect and if there is insufficient clearance between C-126 and the coaxial cable, insulate or reroute the cable.

SHORTING OF COAXIAL CABLE IN THE MBF EQUIPMENT

A source of failure in the MBF equipment has been pointed out. A coaxial cable runs from C-199 to L-113 and

MBF SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

MBF—Transmitter section inoperative. Receiver works satisfactorily.

Cause and Remedy

Antenna transfer relay out of adjustment. Adjust relay so contacts will be made when transmitter is keyed.

SERVICE NOTES**NAVYSHIPS****900,000.1****COMMUNICATIONS****PRESSURIZING KIT, MK-260/U**

Pressurizing Kit ML-260/U is now available for use in maintaining nitrogen pressure in Radio Frequency Tuners TN-197/URT, TN-229/SRT, TN-230/BRT, TN-248/BRT, and Antenna Coupler CU-372/SRT.

Each kit consists of:

- (a) one 7 cu. ft. cylinder of nitrogen
- (b) one regulator gage

(c) 25 ft. of hose together with all of the necessary fittings.

This kit will be placed on the shipboard allowance lists for those ships having AN/URT/U, AN/URT-3, AN/URT-4, AN/SRT-14, AN/SRT-15, and AN/SRT-16 equipment installed. Ships having these equipments may requisition these kits (SNSN F 16-P-580001-151) from the nearest electronics supply activity. One kit is required for every four antenna tuners installed.

MN SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Audio output of receiver gradually became weaker and weaker. Fidelity perfect. All tubes and voltages checked perfectly.

The set became inoperative.

Receiver blocked and unable to receive signals.

MN.--Receiver inoperative and transmitter radiating r-f carrier normally, but with no modulation.

MN.--Signals intermittent and chopped. 60-cycle hum present with squelch ON or OFF.

MN.--Receiving loudly and clearly but unable to transmit. Transmitter tuning normal. TT-1, TT-2, and TT-3 meter readings normal and peaked OK. TT-4 readings normal and coupling to load increased current. 6.3-volt dial lamp lit when placed in antenna jack.

MN.--Recently the sensitivity of our receiver dropped so low that it was almost impossible to hear a station, unless it was almost alongside.

MN.--Distortion and 60 cycle hum present in receiver output. T-R relay did not operate because of low B plus.

Cause and Remedy

Found both dual electrolytic audio bypass condensers C-28 and C-29 had "opened up." When replaced, good normal audio volume was secured.

It was observed that the power transformer T-1 was heating excessively and that the electrolytic filter condenser C-64 was leaking. The components of this equipment became quite hot when used continually in hot weather. The bottom of this set was perforated to allow more ventilation and capacitor C-64 was replaced. The set operated satisfactorily after making the above modification and replacement.

Found to be due to insulation breakdown between the contacts of relay RL-1.

All voltages in receiver from 5 to 10 percent below specified value. Capacitors C-63 and C-64 found to be open-circuited. Replaced from spares.

Antenna transfer switch contact corroded and not making good electrical contact. Cleaned all contacts.

With carrier 4.0, the modulator was assumed to be at fault. All socket voltages of oscillator-modulator tube checked OK as did all associated resistors and capacitors. Some parts were replaced, but all to no avail. Finally, as a long shot, C-64 was checked. The C and R bridge told the story. The capacitance had decreased from 8 to 0.015 mfd.

(Editor's note.--Since C-36 (8 mfd) is in parallel with C-64 it appears that C-36 may also be defective.--C-36 and C-64 form the a-c return path to ground for audio signals in the plate circuit of the 6SL7 modulator section. This trouble might have been detected by connecting the vertical plates of a cathode-ray-oscilloscope from B+ to chassis, speaking into the microphone and noting if audio signals (other than slight 120-cycle hum) were present on the B+ supply. If present, C-36 and/or C-64 are defective.)

The trouble was finally traced to C-32, the local oscillator to first mixer coupling capacitor, which had become leaky under load. This capacitor checked good on the model OE-8 capacitor tester, but when replaced, equipment sensitivity became normal.

The dual electrolytic capacitor C-35, C-36 was leaky. Replaced the defective unit and operation returned to normal.

OPERATING PRECAUTIONS FOR THE MO-1/MAK EQUIPMENTS

Due to the high modulation capabilities of the MO-1/MAK equipments, it is essential to assure that the final amplifier is properly loaded at all times when modulation is applied. Otherwise, dangerously high voltages can be generated which may damage the insulation or the connector plugs. To eliminate the possibility of such damage to the equipments, the following precautions should be strictly observed:

(1) Preliminary tuning should be accomplished with an unmodulated carrier.

(2) Completely resonate the antenna circuit and adjust coupling so as to load the final amplifier to 95 to 100 ma. plate current.

(3) Do not apply modulation under any circumstances unless there is a load of at least 95 ma. on the final amplifier.

(4) With the final amplifier loaded from 95 ma. to 100 ma., 100 percent modulation is easily obtainable. If the plate current is allowed to drop below 95 ma., the transmitter can be easily overmodulated. If the plate current is

more than 110 ma., the plate dissipation of the tube will be exceeded; also, the percentage modulation will be low. Therefore, care should be taken to maintain proper loading on the final amplifier at all times.

(5) When using ICW, it is recommended that the ICW feed-back resistor, R-122, be adjusted so that the percentage of modulation does not exceed 80 percent with the power amplifier loaded to 95 ma.

as 9, the separation between turns in L-112 and L-114

(6) Never attempt to shift frequency with the key down, using ICW. Under these circumstances, during switching, the final amplifier is momentarily unloaded and the insulation can be damaged.

Since there have been several failures of connector plugs in these equipments which are directly attributable to improper operation, strictest compliance with the above precautions is recommended. In this connection, it is suggested that a notice be posted near the equipment, reading as follows:

WARNING

With The Final Amplifier Loaded To Less
Than 95 MA. Plate Current

TELETYPE CIRCUIT TESTING DEVICE

A device has been suggested for testing and aligning the Model 14, 15, and 19 teletypewriter sets. With slight circuit changes, it can be used to test and align all the various types of telegraph repeaters, concentrators, package units, etc., which use relays of the 255A type.

The circuit diagram is shown in Figure 1; Figure 2 shows the completed test before and after assembly. The list of parts required is given in table 1.

In use, the operating relay is removed and the test unit substituted. Rotating the selector switch through its four positions will then provide an instantaneous check of the line, bias, marking and spacing circuits under test. These circuits can be balanced by this same method.

TABLE 1

List of materials for Circuit Testing Device

- 1-Meter, Milliampere DC Type USN CAY-22058-A
- 3-Screws, self tapping, round head 4-40x3/8 inches
- 4-Screws, self tapping, flathead, 4-40 x 3/8 inches
- 8-TE No. 117905 terminals w/nuts and washers

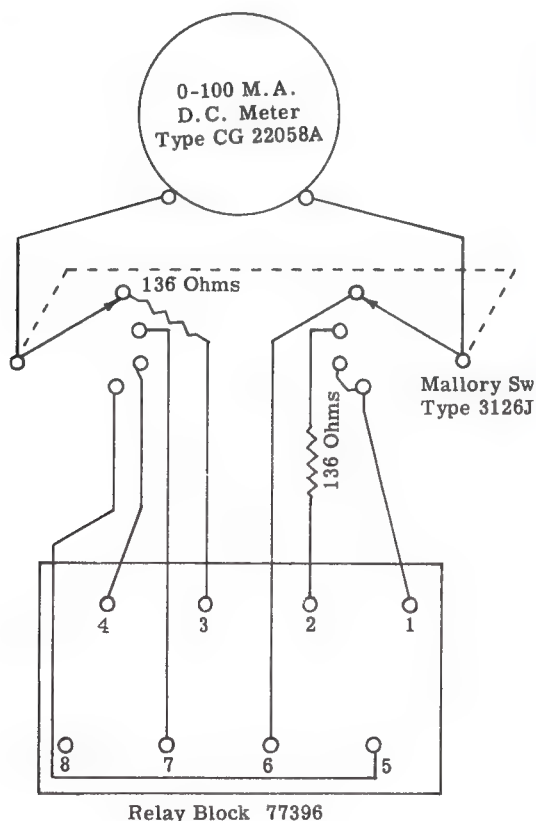


Figure 1

1-TE No. 77596 terminal block

2-TE No. 99848 post

4-TE No. 99847 Washer

2-TE No. 99846 nuts

2-TE No. 99849 Post

2-136 Ohm Resistors

1-Metal can of approximately 1/16 inch material; open in one end and with a hole in the other to fit meter. Inside dimensions should be 2-11/16 inches square x 4-1/2 inches deep.

This unit will enable an inexperienced technician to quickly determine whether trouble is electrical or mechanical and if electrical, to isolate the defective circuit. He also points out that the unit could serve to eliminate the necessity of sending both a mechanic and a technician on service calls.

The Bureau believes the proposed testing device has merit as a basic trouble shooting aid but does not feel that quantitative information can be obtained by its use.

Teletypewriter Test Set TS-660/UG (Western Electric 161A1), NAVSHIPS 91157, is specifically designed for such tests and is the preferred equipment for this application. The above information is furnished to permit those activities who so desire to fabricate the suggested testing device.

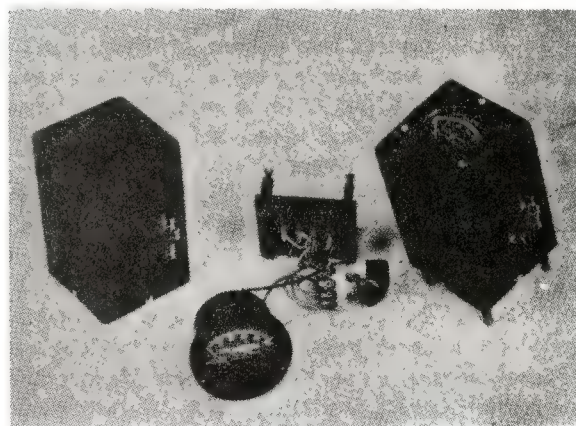


Figure 2

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****WIRE REPLACEMENT IN MODELS 15 AND 19 TELETYPEWRITERS**

On Models 15 and 19 teletype machines the existing solid wire connection from point No. 4 on the line relay mounting block to the 400-ohm resistor should be removed and a stranded wire put in its place. The existing solid wire connection becomes loose, broken, or develops a high-resistance soldered joint due to the vibration of the machine, causing disruption of communications on the circuit.

The trouble caused in these instances most often appears only when the machine is operating. Thus, due to the complex nature of a teletype machine circuit when operating with a case of intermittent trouble, this fault is a very difficult thing to trace.

The recommended flexible connection will serve to cushion vibration between the two points and help prevent trouble from developing there.

FAILURE OF WE 323-A TUBES IN THE MODEL 19 TELETYPEWRITER

Reports indicate that a great number of failures are occurring in the WE 323-A tubes due to open filaments. These tubes are used in the REC-30 rectifier, a part of the 19 teletypewriter.

The trouble, in most cases, is due to poorly soldered pin connections on pins 2 and 4. Eventually, it seems as though a high resistance develops at these points due to oxidizing or corrosion, which throws all the load on pins 1 and 5.

The seven-ampere filament current plus the anode current is too much for the soldered connections inside the tube base, causing the solder to melt out. This results in the filament showing an open-circuit when checked at the tube pins.

Such a large number of failures occur in some areas that it is almost impossible to obtain replacements. In one particular case, in order to keep the 19 TTY in service the following experiment was performed:

(1) By tilting the tube on its side, it is possible to inspect the filament. If the filament seems to be in good

condition saw off the bakelite base 1/4 inch above the bottom of the base, being careful not to injure the wires from the tube to the base pins. Do not cut higher than 1/4 inch or you may break the tube seal.

(2) Using a hot soldering iron on the pins of the tube base, carefully remove the sawed off section of the base.

(3) Check the filament for continuity. If it is not open-circuited, resolder the connections inside the tube base (1 to 2 and 4 to 5).

(4) Tin the leads to pins 2 and 4 (copper leads). Clean the solder out of the pins and insert the wires in their proper pins. Tape the tube base with friction tape and serve with serving twine. (It gets sticky from the heat but it will hold).

(5) Turn the tube upside down and fill the pin holes with solder, making sure some solder runs down on the wires for a better connection.

In the case mentioned, 85% of the "burned out" tubes were reclaimed and placed back in service.

SERVICE NOTES**NAVSHIPS****MODEL 28 TELETYPEWRITER PAGE PRINTER**

Undue wear of the print hammer and type pallets of the Model 28 page printer (TT-47, -48, -69, -70, -171) will be prevented if the pertinent adjustments are checked each time the typing unit is lubricated. These adjustments are as follows (figure and page numbers refer to Teletype Bulletin 217B):

- Carriage Wire Rope Requirement Fig 59
- Printing Carriage Position Requirement Fig 67
- Printing Hammer Bearing Stud Requirement Fig 67
- Printing Hammer Stop Bracket Requirement Fig 71
- Printing Hammer Operating Bail Spring Bracket

Position—See Note, page 1-71.

If the routine check of the above adjustments is made at each lubrication, wear of the print hammer and type pallets will be negligible.

**MODEL 28 TELETYPEWRITER
EMERGENCY OPERATION**

An emergency measure to operate Teletypewriters Model 28 on 50 cycle power (when 60 cycle machines only are available) has been reported by U.S. Naval Activities, Italy: Replace the 60 wpm gears with 75 wpm gears. The Model 28 printer will then operate at 60 wpm speed with only a small loss in margin.

**Model 28 Teletypewriter
Motor Burn-Out**

Motor burn-out in Teletypewriter Model 28 equipped with series-governed motor has been caused by careless installation of the noise suppressor metal cover, thereby shorting out the motor governor resistor. To alleviate this situation, insert a piece of insulating fiber in the cover to prevent a short circuit.

**ADJUSTMENT OF PRINT HAMMER ON MODEL 28
PRINTER**

The following is reprinted from a Teletype Corporation Information Letter:

"Our attention has been called to the fact that some customers are experiencing undue wear of print hammer and type pallets on the Model 28 Printer.

"Such a situation can develop where the parts involved get out of adjustment and are permitted to operate in that condition for an extended period of time. To guard against this, we recommend that your maintenance procedures be reviewed to provide that each time the typing unit is given routine servicing, the pertinent adjustments be checked and if necessary, remade. These adjustments are as follows (figure and page numbers refer to Teletype Bulletin 217B):

1. Carriage Wire Rope Requirement. Fig. 59.
2. Printing Carriage Position Requirement. Fig. 67.
3. Printing Hammer Bearing Stud Requirement Fig 67.
4. Printing Hammer Stop Bracket Requirement.

Fig. 71.

5. Printing Hammer Operating Bail Spring Bracket Position. See Note: Page 1-71.

"If a routine check of the above adjustments is made whenever the typing unit is lubricated, wear of the print

900,000.1

COMMUNICATIONS

hammer and type pallets will be negligible. Bulletin 217B is being revised to include this recommendation."

**STANDS FOR AUTOMATIC PRINTER OF MODEL 28
TELETYPE (APPLICABLE TO TT-47()/UG, TT-48()/UG, TT-69()/UG, TT-70()/UG)**

A stand or legs to be attached to the model 28 teletype printer to support the printer on either side while making or checking adjustments has been suggested. At the present time the printer can only be rested on its back—making it difficult for the mechanic to check, adjust or replace the parts on either right or left side.

The stand (see illustration) consists of four legs cut from a piece of 3/8 in. hex stock, drilled and tapped for a 6/32 in. by 1/4 in. screw. Each leg is approximately 2-3/4 in. long. The legs are attached to the printer by screws, using holes already provided.

The suggested device is a useful tool during servicing operations, facilitating the handling of the automatic typer on the bench and in placing it in the console. The Bureau recommends the use of this method of support during routine maintenance procedures. The metal legs are not to be left attached to the equipment. No field change will be initiated since it is not considered desirable to permanently add the additional parts to the equipments.

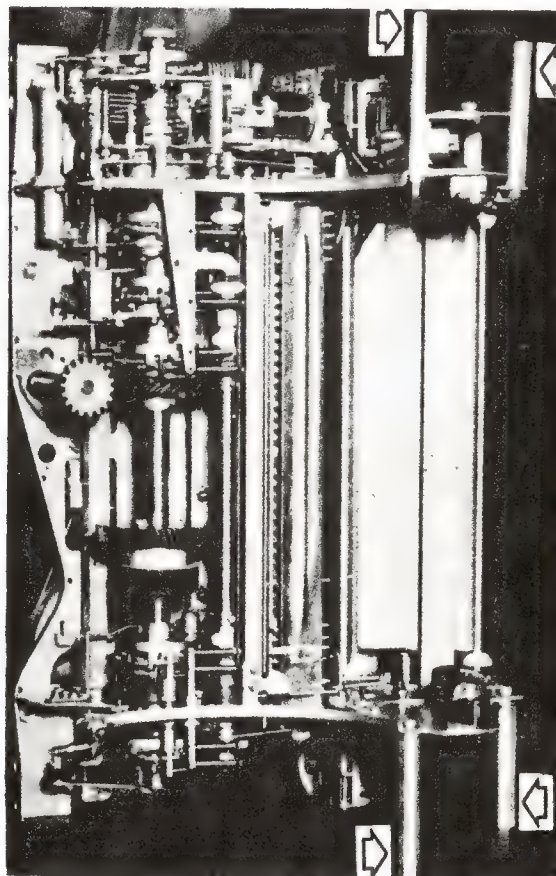


FIGURE 1. Legs for Model 28

ORIGINAL

MOD-28:1

SERVICE NOTES

NAVSHIPS

900,000.1

COMMUNICATIONS

MP-48 MAST BASE

By means of a beneficial suggestion, the Bureau of Ships has been informed that modifying the MP-48 Base by adding a coax adapter to the bottom of the base will reduce the rf cable replacement.

The MP-48 Bases are not usually called for in Navy shipboard installations but when required, the use of an UG-58/U connector is proper.

By adding a coax adapter to the bottom of the antenna base, a coax jumper is made up at the base of the antenna and is fed through to the bottom of the antenna and a tip is soldered to the end of the coax cable. See Figure 1.

All cable shall be solidly fastened to the base of the antenna, so that it will not float free.

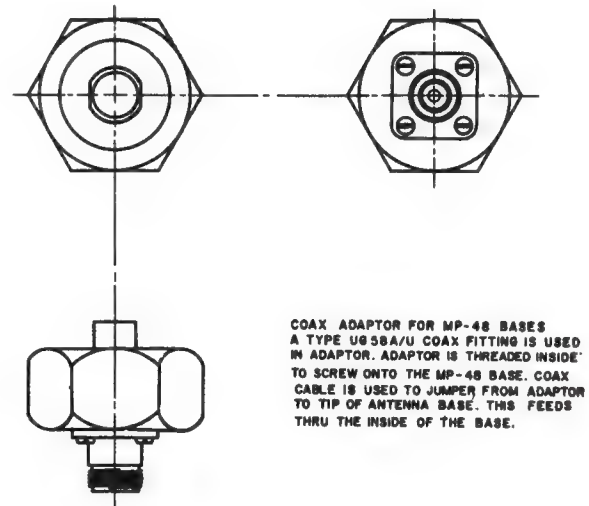


Figure 1

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****MX-1743/SRC - ADAPTER CONTROL WIRING ERRORS**

The Bureau has been advised by the Portsmouth Naval Shipyard, that an equipment wiring and technical manual error has become apparent in the Adapter Control MX-1743/SRC. The equipments concerned are those manufactured by the John R. Hollingsworth Co. under contract N126S-81281.

During an operational checkout, it was noted that the associated TCS receiver audio output at the local and remote stations was reduced to zero when the MX-1743/SRC local audio-level knob was turned fully counterclockwise.

Examination of Figure 4-2 of the MX-1743/SRC Technical Manual, NAVSHIPS 93084, revealed that the wiring to the center and upper portions of R-604 was incorrect. This deficiency is also apparent in the MX-1743/SRC. Reversal of leads to these two points resulted in normal operation.

All ships and activities installing the Adapter Control MX-1743/SRC should check the equipment wiring, modify

if necessary, and correct the equipment schematic in the technical manual.

Paragraph 9.5-6 of the instruction book for the subject equipment indicates that the switch in the power unit disconnects the current-regulator tube and switches the power-transformer primary for operation directly connected to the line filter. The switch in the power unit disconnects the power transformer from the current-regulator circuit but does not disconnect the current-regulator tube from the a-c power line. The equipment therefore continues to require 200 watts. For 60-watt operation it is necessary that the type-876, current-regulator tube be removed from the socket in the power unit and that the switch be thrown to the "out" position.

1 Switch designated as follows: RAK/-1-208 and 209, RAK-2/-3-S-102 and S-103, RAK-4/-5/-6/-7/-8-S-202.

ORIGINAL**MX-1743/SRC:1**

MODIFICATION TO OBQ-1

A modification to the voltage measuring circuit of the OBQ-1 equipment to eliminate the capacity effects from D-C probe, lead to ground, and circuit elements of equipment being worked on and to provide D-C isolation at the probe rather than in the OBQ-1 itself, has been suggested.

The step-by-step procedure follows (See figures 1 and 2):

1. Shunt resistor R34(1 Meg) in OBQ-1 with a short piece of copper wire, soldered securely at both ends. (Figure 1.)
2. Remove existing lead from D-C probe of OBQ-1 and discard.
3. Prepare new single-conductor, shielded lead as follows (figure 2):
 - a. Remove 3/4 inch of rubber jacket from one end (taking care not to cut shield wires).
 - b. Remove 1/2 inch of shield (do not cut into inner rubber insulation).
 - c. Tin the remaining 1/4 inch of shield protruding from under rubber jacket to provide a smooth and non-fraying end.
 - d. Remove 1/4 inch of inner rubber insulation without nicking inner conductor.

e. After cutting off all but 1/4 inch of one pig-tail of the 1 meg. resistor, securely twist together the end of the inner conductor of the cable and the short end of resistor lead in a straight line and solder.

f. Insert resistor-cable assembly into probe so that long resistor lead comes out through probe tip; pull tight and solder. (If necessary, bore out probe handle to accept larger cable.)

g. Remove 2-1/2 inches of outer rubber jacket of other end of cable and unravel exposed shield.

h. Pull all shield wires to one side of inner rubber insulation, twist into a tight, flexible wire, and solder the proper size spade lug or tip to end.

i. Remove 1/4 inch of inner rubber insulation without nicking center conductor. Attach the other spade lug or tip to center conductor and solder. Tape this connection, lapping over both shank of lug and rubber insulation, and serve tightly.

The Bureau considers that this suggestion will increase the usefulness of the OBQ-1. However, since the OBQ-1 is obsolescent, it is not economically justifiable to require a field change to all of these equipments. No field change will be issued. The modification should be made wherever the user feels that it is worthwhile.

RADIO RECEIVING SET R-390A/URR ANTENNA CONNECTIONS

The Operational Test and Evaluation Force, Pacific Projects Division, has reported that many R-390A/URR Receivers, on ships they have visited, are connected to the coaxial antenna cables in such a manner as to impair performance substantially. It is possible that the original yard installation may have been incorrectly made, and the situation may be similar in other ships using these receivers.

There are two antenna input terminals on the back of the receiver; one, J103 marked "WHIP-UNBALANCED" and a second, J104, marked "125 OHM-BALANCED." On all the receivers inspected, the coaxial cable from the antenna patch panel was connected to terminal J103, perhaps the logical place to connect it since the antennas themselves are whip antennas or unbalanced wire antennas. However, this input terminal J103 is intended to be used only where a **very short** wire or cable runs from the antenna to receiver, such as in a vehicular or jeep installation. In the average shipboard installation, the coaxial cable length from antenna to receiver is

many feet. Under these conditions the coaxial cable from the antenna should be connected to terminal J104 using an UG-970/U adapter-connector. This connector is built so that it grounds one side of the input terminal J104, adapting it for use with unbalanced coaxial cables. Figure 10, on page 17, of the **Technical Manual** TM 11-856A, illustrates this connector and page 13, paragraph 15 b-(2) discusses this point.

Incorrect installation can make a very substantial difference in receiver performance. Tests made at 55-spaced frequencies, between 2 and 30 MC on an R-390A/URR Receiver have shown that the average audio output voltage due to signals picked up by a receiving antenna was 123 times, or 42 decibels, greater with the antenna cable connected through a UG-970/U adapter to input terminal J104 than with the cable connected to terminal J103. At ten of the 55 frequencies the audio output voltage was in excess of 500 times greater.

The reconnection is extremely simple to make. Detach the antenna cable from input terminal J103, fit adapter-connector UG-970/U to the coaxial antenna cable, and connect the combination to antenna input terminal J104.

60-WATT OPERATION OF RAK RECEIVING EQUIPMENTS

When one RAK and one RAL are energized by a 300-watt

rotary converter, it is necessary to operate the RAL at 200 watts and the RAK at 60 watts.

RAK SERIES TROUBLE SHOOTING NOTES**Difficulty Encountered**

Noise, erratic regeneration.

Low volume.

RAK-7/RAL-7.—Fouling of band change switch pinion gears.

RAK.—Receiver inoperative.

Very weak signals in receivers. Antenna-to-ground resistance reading low.

Low audio output; loss of sensitivity.

RAK-6.—Lost signal entirely. No regeneration.

RAK-6.—No signals were heard.

Cause and Remedy

Loose and dirty tube shields. Cleaned joints with fine sandpaper made sure shields were tight.

Check receiver attenuator relays for open antenna circuit. Shorten leads to bypass condensers in the vicinity of the band change switch pinion gears.

Found loose connection at J-1 in loop coupling unit.

Upon investigation of the antenna trunk, water was found in its base. The water was up over the entering insulator coming in contact with the antenna lead and causing it to be shorted to the ground. It was found that the water had entered through the seams on the whip antenna and through the standoff insulator which is between the ship antenna and trunk. A small hole was drilled in the base of the trunk and the water was allowed to drain. After the water had drained the hole was tapped and a plug installed.

Audio screen bypass condenser, C-125, shorted.

Found that solder joints between one side of R-114 and one side of R-115 were so close that they touched shoring out R-115. Pushed them apart to prevent further troubles.

Sensitivity check showed 1500 microvolt sensitivity. The setting of the regeneration control was unusually high on those bands on which any regeneration could be obtained and the setting of this control was affected by movements of the sensitivity control. A voltage check showed that the 180-volt B supply was varied by changes in sensitivity control setting. The cause was due to capacitor C-112 developing a 0.25-megohm internal short circuit, thereby biasing the grid of the next stage positive. Replaced capacitor and operation was normal.

HIGH HUM LEVEL IN MODELS RAK/RAL SERIES RECEIVING EQUIPMENTS

In the event that high hum level develops in the models RAK/RAL series receiving equipments, the trouble may be traced to the type 6D6 tubes employed in the detector and audio amplifier stages. It has been discovered that the type 6D6 manufactured by Ken-Rad produces excessive hum when used in these stages. This trouble has been traced to the construction of the heater element. The RCA tubes originally supplied in these equipments have a spiral wound heater, while the tubes in question (a large quantity are on hand at stock depots) use the folded type heater. In circuits employing a high resistance in the grid return or high bias, any leakage of electrons from the a-c operated heater over the top or under the bottom of the cathode to the grid can cause hum modulation. Any type 6D6 available

should operate satisfactorily in r-f circuits and other circuits where the grid return resistance is of a relatively low value.

RAK-RAL EMERGENCY OPERATION

Failure in a submarine's ac power circuits may result in loss of some communications facilities, including the RAK-RAL (receivers). The Portsmouth Navy Shipyard has submitted a method for emergency operation of these receivers if two-way communication is required on power from the TBL (transmitter) motor generator (230 VDC input).

The 220 VAC winding of the TBL motor generator normally supplies filament voltages through a step-down transformer for the transmitter tubes. Only minor changes have to be made in receiver connections, including removal of the RAL ballast tube, to permit series operation of the RAK

and RAL. However, the power output of the generator winding is insufficient to simultaneously supply transmitter-tube filaments and the RAK-RAL so a 230-volt, one-ampere DPDT switch (see figure 1) is required to permit alternate operation of either the transmitter or receiver. The suggested temporary hookup is intended for accomplishment only in an emergency.

The following steps will accomplish the changeover:

(a) Remove the RAK and RAL power supplies from their cases. Throw the voltage-regulator switch to the OUT position on both power supplies. Unscrew and remove the ballast tube V-201 from the power supply that is used with the RAL receiver. Check the power supply used with the RAK receiver to be sure that the ballast tube V-201 has been previously removed. (Caution: Operation of voltage-regulator switch to OUT changes connection of ballast tube from being in series with the input-transformer primary winding to a parallel connection. Ballast tube must be removed to prevent unwanted current drain. Also removing the ballast tube from one power supply but not the other will result in a voltage overload on the other power supply when connected in series.)

Place the RAK-RAL power switch at the radio-room ac distribution panel in the OFF position. Remove the RAK-RAL control unit (mixer) from its case. Disconnect the receiver power supply ac cables from the left-hand terminal strip, (viewed from above), loosen the cable clamp and pull the cables from the case. (Caution: Be sure these are the ac, not the audio cables). Replace the control unit

in its case. Connect the RAK-RAL ac power-input circuits in series by connecting one lead of each ac input cable with jumper leads to the terminals at one end of the DPDT switch.

(c) At the TBL, remove the leads, which connect to the motor-generator set, from terminals 8 and 9. Connect these leads with jumpers to the center terminals of the DPDT switch. Connect jumpers from the remaining two switch terminals to terminals 8 and 9 on the TBL. (Note: Starting from cold tube filaments, about 30-seconds lag between transmission and reception).

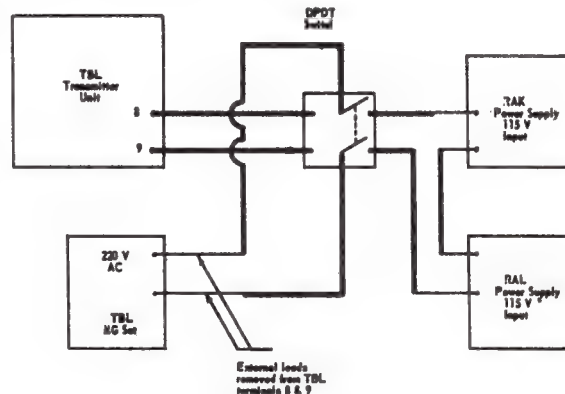


Figure 1

RAL SERIES TROUBLE SHOOTING NOTES**Difficulty Encountered**

RAL-6.—Signals very weak.

RAL-7.—Intermittent regeneration and erratic operation.

RAL-8.—Intermittent reception while tuning toward the low-frequency end on all bands.

RAL-2.—Stray oscillations present on higher frequencies when switch S-15 is in SHARP position, the oscillation persisting even when volume and regeneration controls were set at minimum.

RAL-5.—Very noisy reception with frequency shift whenever the receiver was moved or jarred.

RAK/RAL-6.—Weak output from RAL-6 receiver.

RAL Series.—Receiver dead. No plate voltage on second r.-f. amplifier.

RAL Series.—Receiver not stable, stations drifted across dial, also receiver was very noisy.

RAL-6.—Intermittent operation and erratic regeneration.

RAL Series.—Check or receiver disclosed that it operated normally on all bands but 7, 8, and 9.

Model RAL and other types of receivers were using a common antenna. Reception was very poor on the other receivers when the model RAL receiver was being operated.

Cause and Remedy

Found R-101 in first r.-f. amplifier circuit burned out. Replaced with spare and operation again normal.

Detector tube socket plate prong receptacle discovered to be faulty. Snapped in two, resulting in contact on one side of prong only. Heavy seas or jars would cause signal to drop out. Installed new tube socket, circuit symbol X-103, and normal operation was resumed.

This failure caused by the main tuning capacitor C-102C in the detector stage shorting. This defect was temporarily remedied by placing a small wood spacer under the spring at the end of the rotor shaft nearest the defective section. The failure was permanently corrected by replacing the capacitor.

Feedback was found to be occurring between leads of L-13 (type CRV-53032 low pass filter) and grid lead of tube V-4 (type 6D6), repaired by rerouting leads to L-13 and shielding grid lead of V-4. Receiver then was perfectly stable.

Cleaned and very lightly burnished the rotor and stator contacts of all coil switches which remedied the trouble.

Removing audio leads to control unit from the receiver brought the signal level back to normal. Upon investigation of control unit it was found that an audio lead was grounded by a lug. Ground was removed by bending lug back to shape and normal operation restored.

The "regeneration" windings for bands 4, 5, and 6 on inductance L-108 pass through a steatite ceramic tube on the very edge of the slot that contains the primary windings. The regeneration winding is at ground potential and the primary winding has a potential of 80 volts. As a result of both windings being enamel covered a short developed between them, thereby grounding the plate voltage for the second r.-f. stage. Repairs were made by removing the primary windings, placing a piece of varnished cambric over the slot in the tube at the point where the regeneration winding goes into the hole, and then rewinding the primary over the varnished cambric. This provided insulation between the two windings at the point of the shorting.

Found resistor R-201 in power supply broken with wires making intermittent contact. Normal operation restored by replacement of resistor. The resistor in question is in series with the 874 current regulator tube and opening of the resistor caused loss of regulation.

It was found that the trouble was caused by a bad ground connection on the second r.-f. tube V-102, type 6D6. Normal operation was restored by making proper connection.

Discovered, upon further checking, that the primary winding in the antenna transformer was open—a direct result of, at some time receiving a "shot" of RF. Since this opening was at a terminal connection, it was possible to "jump" the break by a piece of wire. The set then operated perfectly.

Antenna link (shorting link across decoupling capacitor C-101) was found to be closed. Opened the link. Reception then was good with the model RAL receiver in simultaneous use with the others.

RAO SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

RAO-3.—Impossible to receive signals on band "C".

Noticeable background noise received when the r-f and audio gains were full on. Other bands normal.

RAO-2.—No receiver output.

Low receiver sensitivity.

Erratic operation of receiver on 1300-kc. to 2800-kc. band.

RAO-3.—Very low audio output from receiver.

RAO-3.—AVC system inoperative due to excessive negative voltage output.

RAO-2.—Loss of receiver noise with strong signals just audible.

RAO-3.—The slightest vibration would put the receiver out of operation. After much checking the trouble was traced to crystal filter assembly.

Cause and Remedy

The r-f coil assembly was checked and it was found that the plates of the oscillator trimmer capacitor C-121 were shorted. The plates were not bent, but apparently had not been correctly spaced at the time of manufacture. To correct this, the condenser was detached from the coil assembly. The stator plate assembly was removed and unsoldered in the same manner. The stator plates were then respaced and centered so they would "mesh" correctly with the rotor plates. The condenser was reassembled and installed in receiver. Normal operation restored after oscillator realignment.

Investigation disclosed grounded antenna circuit and shorted C-150. Cleared grounds and replaced defective C-150 capacitor. Operation then was normal.

Investigation disclosed dirty contacts on band switching unit. Cleaned contacts and reception was greatly improved.

Found cold soldered joint between coil and terminal in band change circuit.

Trouble was found to be in the audio output transformer T-102, the two secondary leads having broken off completely at the terminal strip. When resoldered to the lugs, normal operation was restored. Apparently, the leads had broken off because they protruded too far above the chassis and were in the way of the coil carriage. Each time the band was changed on the receiver, the carriage hit the leads. Dressing the leads away from the carriage eliminated future troubles.

This was caused by a faulty capacitor C-145 in the grid circuit of V-107B. C-145 had developed a high resistance lead. Operation satisfactory when the capacitor was replaced.

Found that volume control R-121 was open; also coupling capacitor C-138 broken loose at connection. Also found tube socket for first audio tube V-106 defective (rocking the tube in its socket caused the signals to cut in and out). Repaired socket by squeezing connections.

Upon disassembly of IF transformer and crystal filter found a drop of solder in the IF transformer can and bits of corrosion on plates of capacitor C-133. Removed solder. Capacitor was cleaned and lubricated. Receiver functioned properly.

MODEL RBA SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered	Cause and Remedy
Failure of filter chokes L-405 or L-406:	The faulty unit should be taken apart and a repair attempted. In the majority of cases, the core of the choke has either shorted across the contacts or shorted a contact to ground. A repair can be effected by insulating these contacts thoroughly from each other and from the core of the coil. If the coil has had time to "burn out" this repair will not be successful. In this case, a TEMPORARY SUBSTITUTE for the component can be effected by using a 400-ohm, 50-watt resistor. The voltage output remains the same and the hum output will not increase noticeably. This procedure is recommended ONLY AS AN EMERGENCY REPAIR MEASURE. Failures due to internal shorts may be prevented by adapting the procedure described on page RBA: 1.
Weak signals.	Setscrews on coupling from main tuning dial to auxiliary gain control, R-128 were found loose, R-128 was set to proper operating value and coupling secured.—U.S.S. CHANDELEU
Failure of 250-volt d-c meter, M-101	Usually traced to the multiplier, which may be temporarily replaced with a resistor of higher wattage, the resulting error depending on the accuracy of the replacement. Type 6SK7, third r-f tube shorting between elements after warming up. U.S. NAVAL STATION, NAVY 129
Poor operation of low-frequency receivers such as RAO, RBA and RAK when operated in parallel on the same antenna with a high-frequency receiver, such as the RBL, RBB, RBC and RAL.	This is due to the fact that the input impedance of the antenna circuit of high-frequency receivers is very low and, hence, practically short circuits the antenna to ground leaving little signal for the low-frequency receiver with its high-input impedance. The best solution is to provide separate antennas for low-and high-frequency receivers. If con-

ditions are such as to prevent this, the receivers may be decoupled by inserting a condenser in series with the antenna connection of the high-frequency receiver. The decoupling impedance may be mounted inside the junction box on the "Boston" line.

RBA-1—Intermittent operation.

RBA-1—No indication on output meter.

Found poor solder joint on sockets for V-102 and V-107.—U. S. S. STACK (DD-406)
Emergency repair was made by substituting a type-22152 meter found in spare parts for model RAK-RAL series of equipments—U.S.S. LONG ISLAND (CVE-1).

RBA SIMPLIFIED ALINEMENT

The following simplified alinement procedure for RBA equipment has been suggested.

Part I—Alinement of the cw oscillator using LR (Frequency meter):

Aline the RBA by using the calibrator output from the LR equipment. The LR has three convenient outputs of 10 kc, 20 kc and 100 kc. (Refer to Instruction Book for the LR.) The outputs are used as a standard to make the cw oscillator track on all four bands.

Band	Revrr.	LR Freq.	Revrr.	LR Freq.
	Freq.		Freq.	
No. 1	30 kc	10 kc	20 kc	20 kc
No. 2	90 kc	10 kc	40 kc	20 kc
No. 3	240 kc	20 kc	100 kc	100 kc
No. 4	600 kc	100 kc	240 kc	20 kc

When the adjustment has been correctly performed, the 1000-cycle note will increase with an increase in receiver-dial frequency.

Part II—Alinement of RF coils using LP (signal generator):

Use the same frequencies which were used to aline the cw oscillator. Tune the four trimmer capacitors for each band to the 1000-cycle note. Tune for maximum indication on the output meter.

The advantages gained in using this simplified tuning method are: (1) accurate calibration of the receiver of RBA, (2) maximum sensitivity with only a few microvolts input for 1000-cycle indication on the output meter; (3) alinement is accomplished with the reception switch in the cw position with no modulation from the signal generator; (4) alinement procedure time is cut approximately 50 per cent.

RBA SERIES RECEIVERS, RF TRANSFORMERS TUNING MODIFICATION

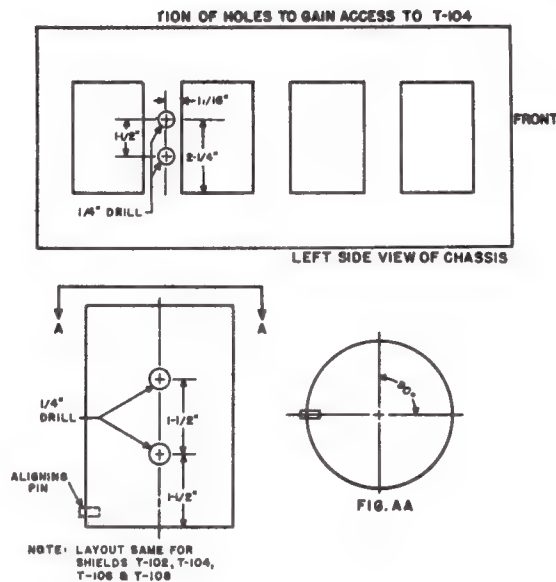
Access to the adjustable tuning slugs of the rf transformers in the RBA series receivers is improved by the modification to the receiver chassis and transformer shields as outlined in Figure 1.

Templates may be made, based upon the outline dimensions given in Figure 1, to facilitate drilling of holes.

TENDER SPARE PARTS FOR THE POWER PACKS OF RBA, RBB, AND RBC EQUIPMENTS

The Bureau has under procurement 200 sets of tender spare parts for the power packs of RBA equipments. These spare parts are applicable not only to the power packs of RBA equipments, but also to those of RBB and RBC equipments. In addition, the Bureau has on procurement 824 sets of stock spares which are applicable to the power packs of RBA, RBB, and RBC. Upon exhaustion of tender spare parts, the Bureau will issue these stock spare parts in lieu of tender spare parts requested by the field. All power packs for these receivers are the same, and all types of spares are 100 percent interchangeable.

Tender and stock spares for the RBA, RBB, and RBC receivers themselves are not interchangeable, and should be requested for the specific receiver required.



RBB-RBC SERIES MODIFICATION OF BAND SWITCH MECHANISM

The following is a suggested method for improving the band-switch stop in the RBB-RBC Series (radio receivers). The details are shown in figure 1.

At present, when excessive force is exerted upon the band-switch knob, the stop pin jams under and passes the stop spring, allowing the tuning mechanism to go beyond its normal range. This can be prevented by installing a number 8-32 screw, as illustrated, to prevent deformation of the spring.

A field change will not be issued to authorize this modification. It is recommended that all activities concerned with this problem adopt the corrective measures on a local basis.

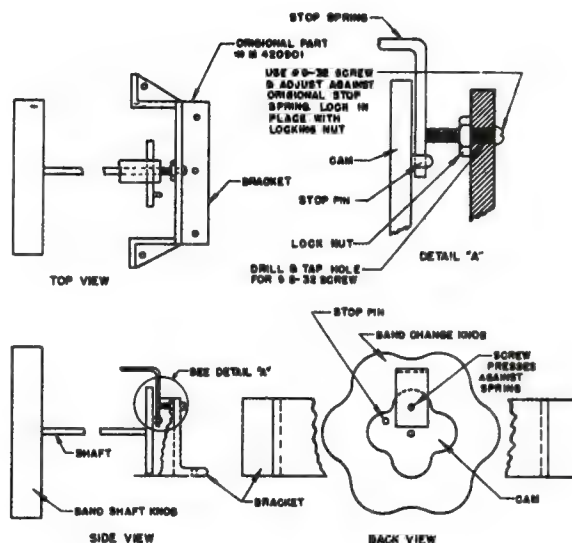


Figure 1

RBB SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Failure of filter chokes L-405 and L-406.

RBB-1.—Receiver dead. All voltages appeared normal.

Bent or broken fingers on band switch.

RBB-1.—Receiver inoperative. The receiver acted as though the antenna circuit was open; i. e. no signals, noise when gain control was advanced.

Failure of 250-volt d-c meter M-101.

Cause and Remedy

The faulty unit should be taken apart and a repair attempted. In the majority of cases the core of the choke has either shorted across the contacts or shorted a contact to ground. A repair can be effected by insulating these contacts thoroughly from each other and from the core of the coil. If the coil has had time to "burn out", this repair will not be successful. In this case, a **temporary substitute** for the component can be effected by using a 400-ohm 50-watt resistor. The voltage output will not increase noticeably. This procedure is recommended **only as an emergency repair measure**.

Condenser C-376 across primary of output transformer was found to be shorted. Normal operation of the receiver was obtained when the condenser was replaced.

An analysis of these failures indicates careless or improper handling on the part of operators, i. e. applying too much force in operating the switch so that the switch fingers are brought against the stop too forcibly, running beyond the stop, thereby causing bend and broken fingers which render the switch inoperative.

The Amperite regulator tube V-206 was found to be open. Normal operation was restored by replacement of the tube. This tube is Amperite type 6-8-B and is used to stabilize the heater voltage on the local oscillator tube V-103. A simple and rapid test for the opening of this regulator tube is to feel the oscillator tube and note if it is warm. Failure of the regulator opens the heater circuit and the oscillator tube remains cold. The ballast resistance is connected to pins #1 and #4 of the tube and the nominal voltage drop across the tube is 10 volts AC. Usually traced to the multiplier, which may be temporarily replaced with a resistor of higher wattage, the resulting error depending on the accuracy of the replacement.

RBB SERIES TROUBLE SHOOTING NOTES--Continued

Difficulty Encountered

Receiver dead, "bulls-eye" lights dimly, dial lamps not lit, shielded cable from power supply very hot, and plate voltage meter reads normal voltage.

RBB/RBC.--The receivers failed to work when receiving c-w signals after equipment had been dusted out or tube changes made.

Receiver completely inoperative.

Set operates with bandswitch between bands and frequently cuts out when bandswitch is properly set on a band.

Cause and Remedy

Caused by short circuit between heater circuit and ground occurring at dial lamp socket. May be checked rapidly by removing dial lamp socket from the chassis ear.

Investigation disclosed that the shield cover on transformer T-306 had been displaced, causing it to short out either or both the capacitors on the top of the transformer, usually the longer one. This failure has been corrected by wrapping a suitable sized piece of light varnished cambric around each of the capacitors on top of the transformer. By doing this, it makes it impossible for these condensers to be shorted out by the shield top in any position.

One terminal of the a.-c. line switch, S-301, shorted to the adjacent shield can (phone junction box). Corrected trouble by utilizing a piece of thin fishpaper 1-1/2" x 2-1/2 inches and using a paper eyelet punch to punch a 3/8-inch hole according to the template below. The fishpaper was bent 90° at the dotted line as shown. Switch S-301 was dismounted from the chassis panel. The fishpaper was placed over the shank of the switch and the switch was remounted with the fishpaper between the switch and the shield can. Trouble was corrected.

R. F. boxes were checked. Upon reassembly bandswitch shaft was noted to be out of line with hole in dial coupling. Dots on switch wafers were correct and the dial was set on proper band for assembly. It was discovered that the set screw in the dial coupling was not directly downward. After examination of the 18 contact switches and the 4 position hand-change mechanism, it was found that in 2 quadrants the bandswitch rotors fell between contacts. This was remedied by lifting the dial stop and moving the dial past the stop with the bandswitch shaft removed. The dial stop was then positioned in order that the dial could not be moved past the stop. This placed the coupling set screw downward to properly meet the bandswitch shaft. The switch rotors were directly on the contacts when the dial was set for any band.

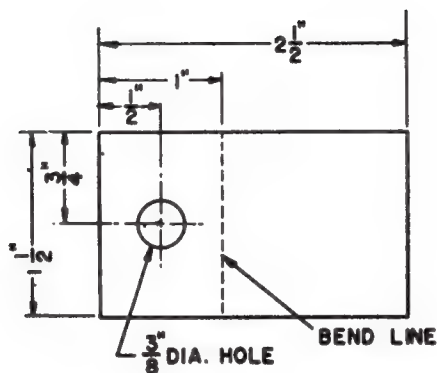


FIGURE 1.--Dimensions for fishpaper insulator

3-RBB-1, 3-RBC-1**METHOD TO DETERMINE ACCOMPLISHMENT**

The following is a simplified method for determining if Field Change 3-RBB/RBB-1 and 3-RBC/RBC-1 has been accomplished.

Field Change No. 3 is applicable to RBB/RBC receivers with serial numbers 1 to 1,000.

To determine if the field change has been accomplished, the following steps should be taken:

1. Remove receiver from its cabinet and place it on its side with the preselector unit on top.
2. Turn band change switch to band 4.
3. Place a mark on the band change switch shaft and, directly opposite, place another mark on the shaft coupling unit. This is necessary to insure replacing the shaft in its correct position.
4. Loosen the Allen head set screw.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS**

5. From the back of the receiver, pull the band switch shaft out 1/2 inch.

6. Rotate the shaft carefully. If rotation throughout 360 degrees is possible, the field change has been accomplished.

If the field change has not been applied, the movable contacts will strike the stop pins and complete rotation will not be possible. Do not force the shaft if it strikes the stop pins; to do so will damage the switch wafers.

SERVICE NOTES

NAVSHIPS

900,000.1

COMMUNICATIONS

IMPROVED METHOD OF INSTALLING CATHODE FOLLOWER ADAPTER TYPE 10563 IN RBC RECEIVER

In the installation of the cathode follower adapter in the RBC, cable "B" should not be run over the top of the I. F.

transformer as shown in figure 3-7 of the FRA book. In several instances this has caused oscillation, apparently in the cathode follower—I. F. combination, which was stopped by routing cable "B" close to the chassis. This oscillation was especially evident when operating the RBC on CW position with the gain well up.

RBC SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Failure of filter chokes L-405 or L-406

Failure of 250-volt d-c meter M-101.

Ser. 64 . . . signal would cut out with BROAD-SHARP switch in SHARP position.

Receiver dead, but produced noise when third i-f transformer was jarred.

RBC-1.—No audio output through phonejack J-303.

Poor sensitivity on 16.5-27 mc. band. Best reception with antenna trimmer at one position.

Signals weak in I-F SHARP Selectivity position.

1 or more bands dead with 1 band satisfactory.

Set operates with bandswitch between bands and frequently cuts out when bandswitch is properly set on a band.

Cause and Remedy

The faulty unit should be taken apart and a repair attempted.

In the majority of cases the core of the choke has either shorted across the contacts or shorted a contact to ground. A repair can be effected by insulating these contacts thoroughly from each other and from the core of the coil. If the coil has had time to "burn out" this repair will not be successful. In this case, a temporary substitute for the component can be effected by using a 400-ohm 50-watt resistor. The voltage output remains the same and the hum output will not increase noticeably. This procedure is recommended only as an **emergency repair measure**.

Usually traced to the multiplier, which may be temporarily replaced with a resistor of higher wattage, the resulting error depending on the accuracy of the replacement.

Audio band pass filter L-301 shorting to ground. Replaced L-301 with spare. This filter was repaired by removing the top of the can and insulating the leads that lay on top of the tar mold.

Found wire to third i-f primary broken at terminal lug in can and making intermittent contact. Normal operation restored by repairing connection.

Found to be caused by L-303 filter choke in audio output stage burned out. Rewound coil, cleaned out the box containing the filter unit and reinstalled.

Receiver was aligned with antenna trimmer at one end of its capacity range. Knob was removed and reset to midposition with capacitor at half-capacity. R. F. was realigned. Operation then normal.

I-F transformer out of line. Realigned with a weak signal from LM frequency meter, coupled by pushing a few turns of insulator wire under the first detector tube. Set vernier at minus 7 and tuned B.F.O. to approximately zero beat; reset vernier to zero, placed receiver in SHARP AUDIO position and set B.F.O. accurately for maximum audio output on an unmodulated signal.

Receiver was properly aligned. Length and tuning of coax lines in parallel to other receivers short-circuited the antenna at some frequencies. Repatched antennas in parallel with this receiver to avoid peculiar conditions.

R-F boxes were checked. Upon reassembly, bandswitch shaft was noted to be out of line with hole in dial coupling. Dots on switch wafers were correct and the dial was set on proper band for assembly. It was discovered that the set screw in the dial coupling was not directly downward. After examination of the 18-contact switches and the 4 position band-change mechanism, it was found that in 2 quadrants the bandswitch rotors fell between contacts. This was remedied by lifting the dial stop

COMMUNICATIONS**NAVSHIPS 900,000.1****SERVICE NOTES****Difficulty Encountered**

Receiver completely inoperative.

Cause and Remedy

and moving the dial past the stop with the bandswitch shaft removed. The dial stop was then positioned in order that the dial could not be moved past the stop. This placed the coupling set screw downward to properly meet the bandswitch shaft. The switch rotors were directly on the contacts when the dial was set for any band.

See RBB series.

MODEL RBG SERIES TROUBLE SHOOTING NOTES**Difficulty Encountered**

Receiver not capable of receiving c-w signals. Beat frequency oscillator dead.

Cause and Remedy

Resistor R-136 badly burned and broken; capacitor C-132-B measured 5000 ohms to ground without tube V-107. Checked and replaced R-127. Replaced R-136 and C-132-B. Receiver then operated normally.

MODIFICATION TO SIMPLIFY OPERATION OF RBH EQUIPMENTS

The Bureau is in receipt of numerous complaints from the fleet which express dissatisfaction with the RBH radio receiving equipment because the multiplicity of controls on the panels of these receivers makes them ill suited for their intended purpose. This equipment has been allotted to the fleet for monitoring aircraft circuits, and was intended for installation at the conning station to be used for aircraft covering circuit watch.

A series of modifications are listed below which, if accomplished, will simplify the control panel of the receiver and make it possible to use the regulator conning station personnel as operators:

(1) The knobs and shaft extensions should be removed from the crystal filter controls after these controls are set to give the desired selectivity. A broad-band response is desirable so the PHASING control should be set at OFF and the SELECTIVITY control set to give the greatest background noise.

(2) The beat oscillator should be rendered inoperative and automatic-volume-control made effective at all times. This is accomplished by turning the CONTROL switch to CWO and then throwing the two toggle switches inside the cabinet associated with this switch. This makes it impossible to operate the switches with the shaft. The knob is then removed.

(3) The r.-f. GAIN control is made semi-adjustable. This is accomplished by removing the knob, sawing a screw driver slot in the end of the shaft and applying a shaft lock such as the Millen type 10061. To adjust the r.-f. gain, it is first set at full gain and a strong station tuned in. The a.-f. gain is then set just below the point where the audio system begins to overload. The set is then turned off the signal, the r.-f. gain is set to give a tolerable noise output from the speaker, and the shaft is locked. Individual experience may suggest a more suitable method of adjustment under operating conditions.

MODIFICATION OF RBH-1 EQUIPMENTS TO PROVIDE CARRIER CONTROLLED NOISE SUPPRESSION ACTION

The following modification to provide carrier-controlled noise suppression action in the RBH-1 radio receiver has been proposed. This modification blocks the audio system

so that no sound is heard in the loudspeaker until a carrier wave comes on. The avc voltage developed by the carrier in the avc tube then unlocks the audio enabling reception of the message.

In the original modification resistor R-148 and switch S-103 which were employed in the "S-meter" circuit have been used, thereby removing the S-meter from the circuit. If it is desired to retain the S-meter feature, an additional potentiometer of 1,000 ohms and an S. P. S. T. switch must be procured and mounted on the front panel on the receiver.

- 1 8-mfd. 450-v. d.-c. electrolytic capacitor.
- 1 1-mfd. 400-v. paper capacitor.
- 1 10,000-ohm, 2-watt resistor.
- 1 24,000-ohm, 2-watt resistor.

The wiring in the receiver is rearranged in accordance with figure 1, utilizing components already in the receiver as required. Resistor R-148 functions as a noise suppression threshold control or an adjustment which determines the strength of the incoming carrier necessary to unlock the audio system. Switch S-103 is used to remove the noise suppression feature if desired. The circuit is adjusted by setting the suppressor threshold control so that atmospheric disturbances are just barely eliminated with the r-f gain full on and no carrier being received. The suppressor circuit is highly sensitive and only a very weak signal is required to trigger it. Sensitivity of the receiver may be reduced by the r-f gain control although too much reduction in gain will decrease or eliminate the avc voltage and as a consequence the suppressor circuits will not unlock the audio system.

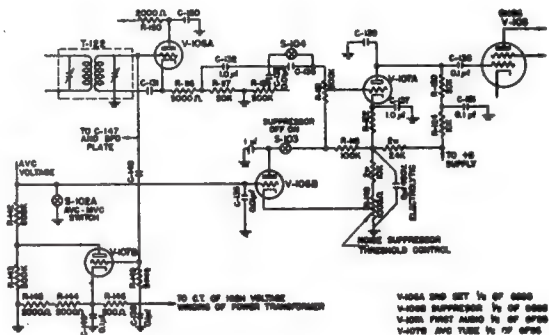


FIGURE 1.--Modification of model RBH-1 to provide carrier-controlled noise suppression action

RBH SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Lack of a-c power.

Cause and Remedy

Check fuse holders F-101 and F-102. This activity has found many of these fuse holders defective. The soldering lug connection through the middle of the hard rubber case to the inside ferrule is often not properly soldered and there is a tendency in this type of fuse holder for the lug to break off. To make repairs, the whole rear and bottom of the receiver must be removed.

COMMUNICATIONS**NAVSHIPS****900,000.1****SERVICE NOTES**

Acoustic feedback, RBH speaker to any microphone.

No signal output. Low plate voltage

Low sensitivity on certain bands.

Volume reduced by over fifty percent when model PD-1 voice recorder equipment was connected to model RBH receivers.

Low sensitivity on band "C".

Power system shorted; operator received shock when he touched receiver. Set insensitive.

RBH-2.--No signals at all getting through the audio-frequency stages.

RBH-2.--Usual receiver background noise but no signals on band C. By jarring receiver, the signals would come in and out.

RBH-1.--Weak or intermittent operation of receiver.

In this instance an RBH was used with a TBL-6. Feedback was eliminated by connecting the TBL-6 keying relay in series with the RBH speaker so that the speaker circuit was open when the transmitter key was closed.

The lead from the primary of the coil in CF-101 had been forced against the side of the shield by gunfire, shorting the plate lead to ground. The CF-101 unit was removed and the lead insulated.

Check for shorted trimmer condenser on band with low sensitivity.

The voice recorder input transformer was grounded on one side while the output transformer of the RBH receiver was grounded at center tap. Corrected difficulty by removing ground at RBH receiver.

Band switching assembly contacts found loose and dirty. This condition was cleared up by cleaning and tightening the contacts.

Discovered a 6F8G tube in the 6C8G socket and a bad 6J5 tube. The line ON/OFF switch was defective and one side was grounded to the chassis. Defective tubes and switch replaced. Set operated normally.

Found C-189 shorted.

Found fixed capacitor in r-f coil catacomb was not soldered to catacomb contact pin. Inspection of pin indicated this. Found by opening the catacomb and prodding the leads to band C coils with insulated screwdriver.

Due to failure of preselector coil to make contact at the same time as the coils in the main part of the receiver. May also be caused by the coil selector mechanism dropping down out of position due to loosening of rods supporting the same. Repaired by readjustment of the coil selector mechanism.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****ANTENNA CONNECTION TO RBK SERIES RECEIVERS**

All RBK series receivers subsequent to RBK (no numeral) should be carefully checked upon installation or when complaints of poor reception are received to make sure that

the antenna is connected to the antenna post and not to the coaxial fitting on the back of the receiver. This fitting is provided for use with a panoramic adaptor.

ORIGINAL**RBK:1**

RBL SERIES TROUBLE SHOOTING NOTES**Difficulty Encountered**

No output.

RBL-2.--Intermittent drop in signal level on band "D."

RBL.--Transmission from TBS transmitter located adjacent to RBL made signals on RBL unreadable.

RBL-2.--Noisy operation of receiver.

Cause and Remedy

Inspection disclosed grounded antenna plug. The grounds were cleared and the receiver operated normally.

Found cold-solder joint where lead from L-114 connects to lug of band switch S-107.

Installed r-f choke in series with antenna of RBL between antenna terminal E-102 and antenna series capacitor C-101. R-f choke consisted of $5\frac{1}{2}$ microhenries 0.85 ohm d-c resistance single layer, wound on steatite core.

Traced a loose screw in the second r-f stage. This screw secured a grounding wire to the chassis. Repaired by tightening screw.

SERVICE NOTES**NAVSHIPS 900,000.1****COMMUNICATIONS****RBM AND LM VINYL COVERING FOR CABLE PLUGS**

It is suggested the black-vinyl extruded covering on covering on RBM and LM cable plugs be substituted for rubber sleeving which dries up and cracks.

The Bureau approves the use of connectors with vinyl tubing whenever the rubber insulation requires replacement.

The vinyl material should be Grade A of ML-I-631 and should not be subjected to temperatures above 75 degrees C.

The adoption of the suggestion is left to the discretion of individual activities.

ORIGINAL**RBM:1**

BURNOUT OF CATHODE BIAS RESISTOR IN RBO EQUIPMENTS

A frequent cause of failure in the RBO is the burnout of the 680-ohm cathode bias resistor (R-145) for the type 6K6GT power-amplifier tube. This is due to inter-electrode short circuits inside the type 6K6GT power-amplifier tube.

During the early production of model RBO receivers, it became necessary to secure a quantity of type 6K6GT tubes on very short notice. A quantity of commercial tubes was available, and these tubes were obtained and used. These tubes were not built to Navy specifications and under conditions of shock and vibration frequently develop interelectrode leakage or short circuits.

It is desired that all installation and maintenance activities remove all commercial 6K6GT tubes from RBO receivers and replace them with Navy standard JAN6K6GT tubes. The commercial tubes may be identified by the

absence of the JAN designation and the Navy Inspector's anchor stamp.

TUBE TYPE 6V6GT/G USED AS POWER AMPLIFIER IN RBO EQUIPMENTS

A type 6K6GT tube was utilized as the power amplifier (V-109) in early production of RBO series receiving equipment. Later production, especially the RBO-2 equipments, incorporated the type 6V6GT/G tube for this purpose.

Tube type 6V6GT/G is the proper tube to use in this application for all models. When the type 6K6GT tubes now used as the power amplifier fail, they should be replaced by the preferred type 6V6GT/G.

The parts list and spare parts lists of the equipment instruction book and its supplements should be corrected with respect to the type listed under Navy type number and manufacturers designation.

RBO SERIES TROUBLE SHOOTING NOTES**Difficulty Encountered**

No audio output.

Output transformer primary or secondary open.

"Cross talk" between channels.

Weak signals in one of the speaker amplifier units (49131).

Very weak signals in monitoring phones.

When first turned on, receiver operated perfectly. After a short period of time, the output suddenly dropped off.

Receiver extremely low in sensitivity on short wave bands and completely dead on the broadcast band.

Equipment would work normally for a period of time, then would suddenly have a loud hum. When gear was checked for open windings, bad condensers or bad resistors, no indication of the cause of the trouble was found.

Low volume on broadcast band of RBO receiver.

Cause and Remedy

Look for open circuit in output transformer Thordarson T-46789.

This is caused by removal of the load from the receiver's output circuit. Under the original circuit arrangement it is possible, for example, that with two RBO receivers on board, all speaker-amplifier units are switched to receiver 1, leaving receiver 2 without a load. The remedy is to modify the RBO receiver in accordance with the instructions on page RBO:1. This will provide a permanently connected load for the receiver.

Due to capacitive coupling between "hot" wires of unbalanced system. Modify RBO in accordance with page RBO:1. Make sure that center of input transformer of speaker-amplifier or speaker-amplifier unit is grounded.

One side of the input transformer was found open. Replaced transformer.

Found lead wire from phone jack J-101 to resistor R-108 poorly connected to resistor. Loose strands from wire shorted out phone jack. Corrected by resoldering the wire.

The screen grid of V-109 (6K6GT) in the output stage was discovered to be red hot. Output tube circuits were checked with an ohmmeter and the primary of the output transformer was found to be open. Replaced the transformer, and the equipment operated normally.

The trouble was traced to a shorted C-107 cathode and screen bypass capacitor. This capacitor was replaced, resulting in normal short wave band sensitivity and excellent reception in the broadcast band.

An open winding in the secondary coil of output transformer T-113 was discovered when the gear was checked in operation. It was found that after an hour or so of operation the secondary winding would open. This transformer was replaced and no further trouble was encountered.

Antenna coil burned out while operating transmitter in the same compartment. Condition can be remedied by disconnecting RBO antenna before keying transmitter.

RBO SERIES TROUBLE SHOOTING NOTES--Continued**Difficulty Encountered**

Weak signals on broadcast band.

Loss of signals on all bands.

Poor sensitivity, poor selectivity, and distortion in RBO (and RCH) receivers.

RBO.-- When in port or very near a broadcasting station, the RBO received the signal clearly. When fifty to a hundred miles existed between the transmitting and receiving antennas, no signal was received. Short wave broadcasts were picked up at night only, and then were very weak and the signals would fade in and out.

Receiver would operate properly at quarter volume but audio output would become greatly distorted as volume was increased.

Audio output was very low and distorted.

Cause and Remedy

Trouble found to be with antenna input assembly, broadcast r-f transformer primary, and trimmer C-149. Apparently a heavy shot of r-f current had passed through units at some time, burning and melting windings of T-103 primary and shorting C-149. Replaced units with spares and realigned broadcast section. Operation returned to normal.

Burned plate filter R-143, and shorted plate bypass C-106-B for oscillator V-102. Replaced from spares and returned operation to normal.

The triple .1 mfd. capacitor in the r-f stage of these receivers found to be leaky. Replaced.

The trouble was found to be a shorted decoupling capacitor (C112A) and an open resistor (R113). When the capacitor shorted, the current through the resistor increased to a value which caused it to burn out. When these two faulty components were replaced the equivalent operated normally.

Resistor R-133 (0.22 megohm) had opened. Replaced R-133 and operation became normal.

Voltage check disclosed zero voltage on screen of 1st Audio Amplifier V-107. Resistor R-138 had opened. Replaced R-138 and operation became normal.

RBS EQUIPMENT TROUBLE SHOOTING NOTES**Difficulty Encountered**

RBS.--Receiver sensitivity was normal but radio output was barely audible.

Cause and Remedy

Found to be due to coupling capacitor C-580 having a leakage resistance of about 40,000 ohms. Replaced capacitor.--U. S. S. SUMPTER (APA-52).

RIGID CABINETS AND HINGED COVERS USED WITH MODEL RBS RECEIVING EQUIPMENTS

Outline dimensions, cable connections and other pertinent information regarding the model RBS series receiving equipment was published in RIB No. 80.

The receiver and amplifier-power units can be separated from the mounting bracket and installed in a normal manner. The receiver may be installed on a standard-operating table or shelf as shown in RIB No. 93.

The rigid cabinet and hinged cover shall not be considered an integral part of the receiver. It is not necessary to use these items when an RBS receiver is installed. The stocking of the cabinets and covers as a separate item apart from the receiver is authorized.

The Bureau recommends that activities follow the methods shown in RIB No. 93 when installing model RBS series receivers. (6/1/47)

FAILURE OF BAND SWITCH IN MODEL RBS RECEIVING EQUIPMENT

The U.S.S. Boxer (CV-21) has reported failure of band switch S-501 in the model RBS radio receiver. The selector ratchet on the shaft of the switch, which is a part of the dial mechanism, came loose from the shaft so that the shaft turned freely.

All ships and stations using model RBS receivers are requested to advise the Bureau of any similar failures in order that corrective action may be taken by the manufacturer.

RBS CROSS-TALK

A beneficial suggestion discloses a possible source of cross talk in the connection between the RBS equipment and the receiver-transfer switchboard. The radio receiver has a ten-watt audio amplifier built into the rectifier power-supply unit for operation with a speaker.

Since there may be some misunderstanding regarding the proper connection of the receiver to remote stations, the following information is a reminder to installing activities.

At a local operating position, the output receptacle (J-503) on the receiver unit provides sufficient audio power for headphone reception. For convenience, two additional headphone jacks (J-904) and J-905) with an audio-level control are located on the rectifier power-supply unit. Also, located on this unit is the speaker receptacle (J-902) which carries the 10-watt output of the built-in audio amplifier. Since remote stations onboard ship intended for voice reception are equipped with individual amplifiers and speakers or combinations thereof, connecting them to this 10-watt output is not necessary.

When the audio output of the receiver is connected to the receiver-transfer switchboard, the connection should be made from the same output level as the receiver-headphone receptacle (J-503); not from the amplified output at the speaker receptacle (J-902).

All ships and maintenance activities should check the connection of the RBS to the transfer switchboard as an improper connection may be the cause of cross-talk.

ANTENNA CONNECTIONS ON MODEL RBS EQUIPMENTS (RIB-205)

An article in RIB 202 recommended the installation of Models RBS series receiving equipments without the splash-proof cabinet. At time of installation, provision must be made for connecting the antenna coax to the equipment. This can be done by installing a type 49120 concentric jack on a bracket as close to the antenna and ground terminals of the receiver as possible, and connecting the jack to the terminals with short jumpers.

On Model RBS-2 equipments, an antenna connection adapter assembly, J-506, is furnished with each receiver, and can be installed on the receiver with or without the splash-proof cover.

ANTENNA CONNECTION ON RBS & TCS EQUIPMENT

Activities having RBS and TCS installations are reminded that coaxial antenna connections may be used on these equipments. This type of antenna connector was approved by the Bureau for use at the option on the activity. An article regarding use with the RBS was published in the Radio Installation Bulletin number 205 which is reprinted below. Information on use with TCS equipment may be located in the Electronic Information Bulletin Number 311.

SERVIEC NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****DEFECTIVE COILS IN RBU-1 PANORAMIC ADAPTORS**

Several RBU-1 panoramic adaptors have been received with defective coils. The iron cores used to tune the r-f and i-f coils were not free to turn inside the paper coil

form. Consequently, the form turned as the cores were adjusted, breaking the connections from the coils to the terminal lugs on the transformer frame. Care should be taken when adjusting the coils in the subject equipments to be sure that the cores are free to rotate.

ORIGINAL**RBU:1**

**REPORTS OF UNSATISFACTORY PERFORMANCE OF
RCH RECEIVING EQUIPMENTS**

Reports received from installation and maintenance activities frequently complain of unsatisfactory performance of the RCH equipment upon installation. The subject of these complaints is the lack of gain, low sensitivity and frequency instability. When the Bureau of Ships assumed control of the technical aspects of the subject equipment several preliminary models were tested and found to be better than any of the other available equipments which would fill the requirements for a non-radiating, low and high frequency communications receiving equipment. The performance of this equipment will not equal that of some other Navy receivers; however, with proper handling it can be made to give satisfactory service.

These equipments were not tropicalized and were not packed for overseas shipment so deterioration may possibly result from long storage periods. Complete re-alignment of the receiver may be necessary at the time of installation. Alignment should be performed by expert personnel carefully following the instruction book procedure because there is considerable interaction between frequency bands, and one band cannot be adjusted without affecting the adjustment of the other bands. Several repetitions of the alignment procedure may be necessary to obtain the best sensitivity and gain.

Overloading on strong signals accompanied by pulling of the oscillator frequency can be prevented by maintaining the gain control settings as low as possible consistent with adequate audio output.

RCH RECEIVER TROUBLE SHOOTING NOTES**Difficulty Encountered**

RCH.--Oscillation in either voice or CW reception.

Cause and Remedy

Trace to open capacitor C-123 between plates of diode V-107 and plate of V-106.

FAILURE OF PHONE CONTROL SWITCH S-103

Phone control switch S-103 operates in both the primary and the secondary circuits of the output transformer. When the equipment is operated with no load on the secondary of the transformer, extremely high audio voltage peaks occur across the primary winding and causes voltage breakdown between the two circuits of the switch and between the switch contacts and the grounded switch supports. It is important that a 600-ohm load be permanently connected to the 600-ohm speaker terminals to prevent the occurrence of these high voltage peaks. If a speaker is not used or if the speaker is disconnected, a 600-ohm resistor must be connected across the speaker terminals E-102.

In installations where no speaker is used it may be advantageous to set the PHONE OUTPUT ADJ. (screw-driver adjustment on left end of cabinet) to maximum to permit operating the gain control at a lower level.

In installations where there is no application for switch S-103 and arcing still occurs after applying the precautions described, the d-c portion of the switch can be removed from the circuit. Disconnect the three switch wires from the number three pin of V-110 and terminals B and P of T-120 (the wire from terminal B of T-120 to C-102 must be left connected). Connect a new lead from terminal P of T-120 to the number three pin of V-110. The 600-ohm load on the speaker terminals must still be maintained to avoid damaging the transformer.

ADAPTING RCK AND TDQ FOR CCL SERVICE AT SHORE STATIONS

The following field change is recommended in order to relieve the shortage of the TDG-1 and RBQ-1 transmitter and receiver which are presently utilized with the UN (Western Electric Type 42-A-1) Carrier Control System and also in order to fully utilize the capabilities of the Army CF-1 four-channel telephone terminal when utilized alone or when the Type CF-1 terminal is utilized with the Navy Model UF Carrier Telegraph Equipment.

To obtain best use of the Army Type CF-1 telephone terminal the u-h-f transmitter and receiver should have a flat frequency response up to 12 kc. The unmodified TDQ transmitter is down about 16 db at 10 kc and the unmodified RCK receiver is down about 8 db at 10 kc when ban switch is set to "wide."

In their present form the Models TDQ/RCK combination will permit use only of channels one and two of the four channels of the Type CF-1 terminal.

INSTALLATION NOTES COVERING RCK SERIES RECEIVING EQUIPMENTS

The RCK series receiving equipments have been developed for use with the TDQ series transmitting equipments. These receivers are the first of a new series of equipments in which the i-f, audio and power circuits are standardized and the r-f, oscillator and mixer circuits are varied from model to model.

The RCK is a superheterodyne receiver designed to receive signals on any of four crystal controlled frequencies within the range of frequencies covered by the model TDQ transmitter. The model RCK receiver is approximately 11 inches high, 18 inches wide and 18 inches deep and weighs approximately 115 pounds. Power requirements are 106 watts at 110-120-volt, single-phase, 55-65-cycle AC. The tube complement is as follows:

No.	Type	Function
1	956	R-F amplifier
1	717A	Converter
2	717A	Multipliers
1	6N7	Crystal oscillator-multiplier
5	6AB7	I-F amplifiers
1	6H6	Second detector-peak limiter
2	6AB7	Audio amplifiers
1	6V6GT	Audio output amplifier
1	6U4G	Rectifier
1	VR150/30	Voltage regulator

The power output is 15 milliwatts into a 600-ohm load. A single tuning control operates seven tuned circuits. This control has four mechanical detents which are present in accordance with the frequencies of the crystals in use. Change of frequency is rapid and the operating frequency to which the receiver is tuned is indicated by the "lighting up" of one of the four bull's-eyes over the tuning dial.

The receiver chassis is designed to be removed from the cabinet by loosening the thumbscrews on the front panel and sliding the entire chassis assembly forward on the guide strips on each side of the cabinet. The mounting base to which the shock mountings for the receiver are attached is drilled with four holes through which 3/8" bolts of the proper length may be attached to fasten the receiver to a bench or table.

In planning an installation, care must be exercised to provide adequate clearance (minimum 1/2 6-1/4") from the back of the receiver to the bulkhead or nearest obstruction to provide access to the power-input plug, antenna-ground plug, speaker plug, silencer plug, and fuses.

The antenna input circuit is unbalanced to ground and is intended to terminate a 50-ohm transmission line. When used with the TDQ series transmitter, the receiver input jack should be connected to the normally open position of the antenna changeover relay in the top chassis section of the transmitter.

Terminals are provided on the rear of the chassis for connection of 600-ohm speaker circuits. Speakers or speaker-amplifiers used in conjunction with the RCK receiver should be operated with taps adjusted on the line side of the matching transformers for optimum impedance match.

Sufficient slack should be left in connecting cables to permit withdrawal of the chassis from the cabinet without necessitating removal of plugs. An angle adapter on the antenna input plug should not be used; it will prevent withdrawal of the chassis without removal of the plug.

Complete instructions regarding the setting of the dial detents, alignment, and adjustment are contained in the instruction books. In conformance with recent practice, the instruction books also contain a complete table of point-to-point voltages and resistance for use in servicing.

OPERATION OF LOUD-SPEAKERS WITH RCK SERIES RECEIVING EQUIPMENTS

The RCK receiving equipment employs two stages of audio-frequency amplification which feed a power-amplifier output stage. The design is such as to impress a constant voltage (within three decibels) across the primary winding of the output transformer. This voltage is independent of changes in load resistance across the secondary terminals of the transformer from 600 to 30 ohms.

The maximum available undistorted output from the equipment is 100 milliwatts for a 600-ohm load. For a 30-ohm load, the power output is 850 milliwatts. The corresponding figures for resonant overload are 150 milliwatts and 1.35 watts. Thus, the RCK is capable of operating a loud-speaker, such as the type 49155, having a 30-ohm impedance and a nominal power input rating of 2 watts. If the RCK is to operate into a 600-ohm load, an amplifier-speaker such as the type 49131 will have to be employed for satisfactory loudspeaker reproduction. The audio-frequency output characteristics of the RCK equipment are approximately the same as the corresponding characteristics of the RBB/RBC receiving equipments and the same

treatment would apply to these latter equipments when loud-speaker operation is considered.

RCK C-113 CERAMIC SHAFT

Several reports of breakage of the ceramic shaft of the capacitor, C-113, have been reported. A large number of these failures can be attributed to improper maintenance. In some cases the five screws under the preselector unit which "jig" and secure the dial assembly in place have been replaced improperly. This has resulted in a loose dial assembly causing the ceramic shaft to crack. These screws should not be touched ordinarily and are painted red to call attention to this fact. Removal of the screws during routine removal of the preselector bottom plate places undue strain on the ceramic shafts causing breakage. Therefore—DON'T TOUCH.

INCORRECT VALUE OF RESISTOR R-246 IN RCK EQUIPMENTS

NYMI has reported to the Bureau that resistor R-246 in many new RCK receivers varies from 55,000 to 100,000 ohms. The correct value of this resistor is 47,000 ohms $\pm 10\%$, and unless this value is used, it is impossible to adjust the input meter to zero set. Activities experiencing this trouble should check the value of resistor R-246 and replace it if it does not read approximately 47,000 ohms.

PROPER CONNECTIONS BETWEEN RCK EQUIPMENTS AND TYPE 49155 LOUD-SPEAKER UNITS

The design of the audio output circuit of the RCK receiver is such that maximum audio power is available at the speaker jack J-304 when the actual load impedance is much lower than 600 ohms. Therefore, for satisfactory operation of single loud-speaker units of type 49155 with the model RCK, the 30-ohm input taps on the speaker unit should be connected to the receiver output, even though the latter is designated 600 ohms.

CRYSTAL FAILURES IN RCK AND TDQ SERIES EQUIPMENTS

Reports from the field indicate frequent failures in the crystals supplied with the RCK and TDQ series equipments, resulting in failure of the oscillator circuit. Inability of the crystals to oscillate is due to manufacturing processes in the factory producing these crystals. These processes have been analyzed and corrective measures taken which it is believed will relieve the situation.

The Naval Research Laboratory and the manufacturer of the RCK and TDQ crystals are conducting further investigation in an endeavor to determine other possible causes of crystal failures. In order to carry out these investigations it is requested that all cognizant Naval activities and field personnel assist as follows:

RCK:2

(1) All defective crystals for RCK and TDQ equipments should be immediately returned to the Naval Supply Center, Norfolk, Va., untouched, unopened, and with seals unbroken if sealed.

(2) Failure reports should be submitted to the Bureau for each crystal sent to the NSC, Norfolk, Va. The failure report should state that the crystal has been sent to NSC, Norfolk, Va. Replacement crystals should be requested from the Naval Supply Center in accordance with Chapter 67 of the Bureau of Ships Manual.

RCK ALIGNMENT IN LESS TIME

In order to properly align Radio Receiver RCK, it is necessary that all covers be in place, especially the RF covers. These covers have holes through which an alignment tool may be inserted. It has been brought to the attention of the Bureau that these holes are unmarked, necessitating frequent reference to the pictorial view in the instruction book during alignment procedures.

It has been suggested that these holes be marked with their appropriate designations (such as C-101, E-202) in order to eliminate the need of referring to the instruction book for hole locations. The Bureau concurs that this suggestion will save time in the alignment procedure. A simple method is to type the appropriate designation on a small piece of paper and attach this by means of transparent tape adjacent to the hole corresponding to the symbol number.

REPLACING BROKEN VARIABLE CAPACITOR SHAFTS

Two suggestions have been approved which, because of their interrelation, are combined in this write-up to avoid any confusion which might arise from their separate publication.

The basic suggestion consists of replacing broken ceramic tuning capacitor shafts with shafts fabricated from GMG glass fiber (Melamine) rod.

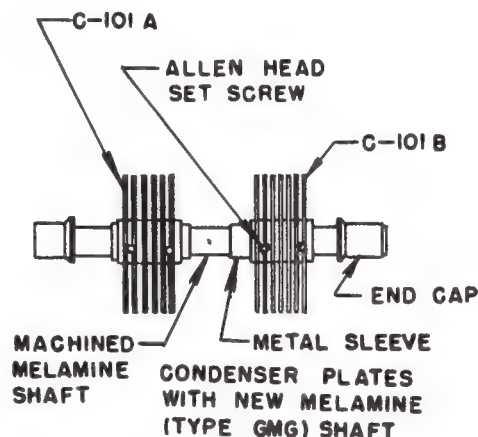


FIGURE 4. Showing New Shaft Installed.

ORIGINAL

SERVICE NOTES

NAVSHIPS

900,000.1

COMMUNICATIONS

The following is one method for repairing tuning capacitors (C-101 and C-113) in RCK equipments. The new shaft is machined to fit and the original metal sleeves and end caps are remounted (press fitted) on the shaft. Each capacitor plate assembly is secured to its metal sleeve by two Allen Head Set Screws. (See illustration.) This method is satisfactory for repairing these capacitors, which are not available in the electronics supply system.

The following method is for repairing the tuning capacitors in the RF and multiplier sections of RDZ equipments. The 17/64-inch diameter shaft is machined from a 5/16-inch diameter rod. Capacitor rotors must be aligned on the

shaft so that proper meshing of rotor and stator plates is obtained. Realignment of the RF and multiplier sections will be necessary after reassembly of the equipment.

Machined surfaces of the new shaft should be coated with Insulating Varnish Compound, **N5970-511-8953** to reduce the effect of humidity.

Repairing the tuning capacitors by installing the new shaft, compared with the former practice of replacing the whole unit, saves material and reduces maintenance costs.

MODEL RCK SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

No audio output.

RCK.--Inability to zero the input meter.

Receiver had very low sensitivity.

Cause and Remedy

Discovered one lead from capacitor C-243, on the side going to the second amplifier grid, was so close to chassis that voltage arced over to ground. However, it did not read "short" when measured to ground with an ohmmeter. Bent lead away from ground and replaced shorted capacitor, from silencer diode to second amplifier grid, with spare capacitor. Operation was again normal.

Resistor, R-246, found to be outside 10 percent tolerance limit. Replaced resistor. Normal operation restored.

Faulty operation was traced to a defective high-frequency trimmer capacitor C-113. This capacitor is made up with a "slug" type adjustable screw. The "slug" had expanded and would not clear the tubular part of the capacitor. The capacitor was removed and the "slug" sanded down. The capacitor was reinstalled and the receiver operated normally.

ENTERTAINMENT RECEIVERS FOR NAVAL VESSELS

RCU, RCU-1, and RCT radio-phonograph equipments, manufactured primarily for commercial use, have been added to the electronic material allowance for certain Naval vessels by the Chief of Naval Operations.

Some of the more important characteristics of these equipments are as follows:

Frequency range . . .	535 kc. to 18.4 mc., continuous coverage in three bands.
Record player	RCU and RCU-1 automatic; RCT manual.
Weight.	175 pounds.
Type of mounting . .	Deck.
Power requirements	180 watts, 115/230 volts, 60 cycle, single phase, a.c.
Spare parts	Contained in box inside cabinet.
Record stowage	13 $\frac{3}{4}$ " high, 24-7/8" wide, 13-7/8" cabinet dimensions deep, and 67 pounds. and weight.

Inasmuch as these units were manufactured primarily for commercial use, no mounting facilities were provided for shipboard installation. It is therefore recommended that these equipments be fastened to a bulkhead by means of four hooks and padeyes. The padeyes should be attached to the equipment near the top and close to the bottom on each side of the unit with the corresponding hooks welded to the supporting bulkhead. This method provides a sturdy installation and will permit the unit to be unhooked and pulled out whenever servicing becomes necessary. Extreme caution should be exercised in attaching the padeyes to the sides of the wooden cabinet as the wood is easily damaged.

These receivers do not meet current requirements insofar as receivers radiation is concerned and, when installed in vessels, shall be considered as "strip ship" items.

FAILURE OF FILAMENT BALLAST REGULATOR TUBE IN RD-92/UX FACSIMILE RECORDER

Activities report the failure of ballast-tube thermal resistor V7 (Amperite type 6-36) which regulates the a-c series filament current for all tubes in the RD-92/UX Facsimile Recorder. (Refer to Symbol V-7 in NavShips 91401, Instruction Book for Facsimile Recorder).

In case of a failure and where a replacement is not immediately available, it is recommended that an 80-ohm, 50-watt resistor be substituted to maintain operation.

To effect this temporary repair, break the glass bulb of a defective 5Z3 or other 4 pin tube and remove the elements. Insert conductors in the tube base connection pins 1 and 4 and solder. Connect and solder the other end of the two conductors to the terminals of the resistor. Insert the tube base in the ballast tube socket XV-7. The resistor should be located external to the recorder in a well ventilated space.

With the RD-92A/UX Facsimile Recorder, a ballast-tube thermal resistor V-7 (Standard Navy Stock Number N16-R-85006-1525) is provided in the equipment spares. (12/1/52)

FACSIMILE RECORDER RD-92/UX

A mechanical "veedor root" counter (Symbol Designation 0-480, Standard Navy Stock Number N16B-750001-438) bracket and associated gears is installed on the RD-92/UX equipment. This mechanism is not installed in the RD-92A/UX equipment. See the instruction book for RD-92/UX, NAVSHIPS 91401.

The mechanism installed on the RD-92/UX indicates a count for every twelve revolutions of the recording drum for the purpose of indicating the approximate time that the equipment is in use. This mechanism is not required in the operation of the recorder.

Equipment and stock maintenance parts for these counters were not provided and none are available. In the event that the counter on RD-92/UX equipment becomes defective, it should be removed from the equipment.

RD-92/UX MOUNTING RAILS

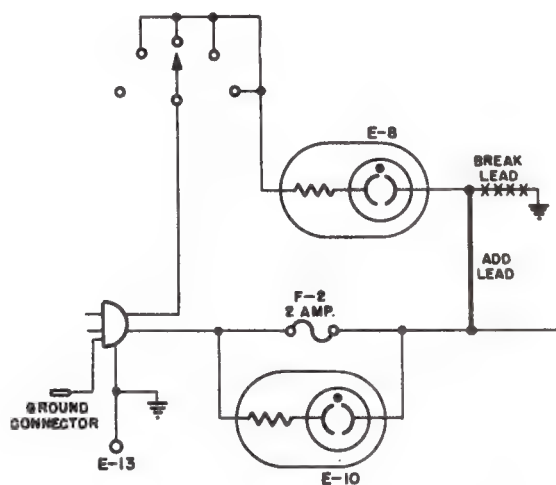
Field activities have reported that the on-off indication of the neon pilot lamp E-8 of Facsimile Recorder RD-92/UX is not definite when the Recorder is operated from an ungrounded-primary-power-input line. For this type of installation, the Bureau authorizes a rewiring of Pilot Lamp E-8 in accordance with figure 1.

After the equipment has been changed, make appropriate entries on the equipment history card and in instruction books.

Due to the minor nature of the modification, a field change will not be issued.

FACSIMILE RECORDER RD-92/UX

In a beneficial suggestion, it was suggested that activity using the RD-92/UX Facsimile Recorder cut 1/4-inch of bakelite off each corner of terminal board TB-2 as an aid to maintenance. This will allow TB-2 to pass through the meter opening in front panel when test meter M-1 is removed for repair.



CORRECTIONS TO SCHEMATIC DIAGRAM FIG.13 OF NAVSHIPS 91401

NOTE: THIS DIAGRAM IS INTENDED AS AN AID IN REWIRING E-8, IT IS NOT A COMPLETE DRAWING OF THE RD-92/UX.

Figure 1

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****RD-115/UN, RD-115A/UN, RD-119/UN REPLACEMENT
OF RECORDING & REPRODUCING HEADS**

The recording and reproducing heads for the RD-115/UN, RD-115A/UN and RD-119/UN should be ordered in matched sets of 4, Standard Navy Stock Number N17-HO39209-2501, (FIIn 5939-312-166a). The manufacturer recommends that the complete set of heads be replaced when necessary, due to a very noticeable difference in quality of reproduction when worn and new heads are used together.

RECORDER-HEADS FOR RD-115/UN & RD-115A/UN

To prevent excessive wear to the recorder heads on models RD-115/UN and RD-115A/UN Recorders, instructions

for adjusting the pressure gate should be followed closely. These instructions will be found on page 65 of the Technical Manual for Model RD-115/UN and on page 73 of the Technical Manual for RF-115A/UN.

If the recorder-heads become magnetized, they need not be replaced by a new set of heads, as demagnetization can be accomplished by following instructions in the technical manual. These instructions are found in page 56 of the Manual for Model RD-115/UN and on page 63 of the Manual for RD-115A/UN.

ORIGINAL**RD-115/UN:1**

SERVICE NOTES**NAYSHIPS****900,000.1****COMMUNICATIONS****RD-133/UN DEFECTS IN RECORDER**

The following information was submitted by the USS SNYDER (DE-745):

1. Recently, while testing Tape Record type RD-133/UN installed on board this command, it was found to have a very low output on the playback position after recording voice material. The recorder-reproducer head was changed, resulting in better output but still not up to the required standard. Upon inspection of the chassis, six electrical connections were discovered which had apparently never been soldered. After soldering, tests were conducted with satisfactory results.

2. Specifically, the following unsoldered points were noted: both wires leading to C26; one wire on S2-a; two wires on S2-c; and one wire on R-29. C26 and R-29 were soldered on the terminal board prior to installation, but the wires leading to these points were only wrapped.

The above problem is a result of a mistake in assembly and not a design fault. The manufacturer has been advised of this problem and requested to correct procedures.

ORIGINAL**RD-133/UN:1**

RECEIVER BURN-OUT

The Bureau was advised by a field activity that frequent outages were occurring in RDM receivers being used with i-f type converters and without an audio load. Under this "no-load" condition the plate dissipation of the 6K6 output was exceeded causing the tube to short. The shorted output tube would then cause a burn-out of either the output transformer, the filter choke, or the power transformer. This type of failure may be largely eliminated by connecting a 500 ohm 5 w. resistor across terminals 1 and 2 of TB-4, which is located in the rear of the chassis. This resistor will place almost a normal load on the output

tube but will not interfere with headphone reception. It should be removed when use of the loudspeaker is required.

If, under conditions of extremely high ambient temperature and high line voltages, the resistor does not offer sufficient protection, a 1/8 amp fuse may be installed between pin 2 of X-14 and L-50. As wired at the factory the original lead also serves as a filament lead for V-14. Care must be taken that the fuse is not inserted in the filament lead. The fuse may be mounted in an extractor type fuse holder mounted in a convenient spot on the rear apron of the chassis.

Where required, the foregoing modification is authorized without report to the Bureau.

PROCEDURE FOR MEASURING THE SENSITIVITY OF RADIO RECEIVING EQUIPMENT RDO MODIFIED BY FIELD CHANGE NO. 2-RDO

With the modification of Radio Receiving Equipment RDO by Field Change No. 2-RDO, which adds a preamplifier stage to the IF input, a new procedure for **sensitivity** measurement is required. The stage gain sensitivity measurements given in table I, section 4, page 26, paragraph 14, of the Technical Manual for Radio Receiving Equipment RDO (NAVSHIPS 900,527-1B) are no longer applicable in this case.

The procedure described below is to be used to determine the overall sensitivity of the receiver. The procedure given in the instruction book for **alignment** of the IF stages, section 4, paragraph 14, is NOT superseded by the procedure described below and must still be employed for receiver alignment.

1. Remove RDO Receiver from the cabinet. Insert the TN-2B/APR-1 tuner unit.
2. Remove the bottom shield cover from the IF-AF amplifier chassis.
3. Connect the positive test lead of a vacuum-tube voltmeter to prong 5 of tube socket X-207, and ground the other test lead on the chassis. Set the vacuum-tube voltmeter on the lowest voltage range.
4. Connect the RDO Receiver to the power source.
5. Connect the Signal Generator LAF series to the antenna input of the TN-2B/APR-1.
6. Set the signal generator to 200 mc.
7. Tune the TN-2B/APR-1 to the signal generator output.

8. Set the following receiver controls:
 - a. The RECEPTION switch to "AVC-OFF" position.
 - b. The NOISE LIMITER-OUTPUT METER switch to "OFF" position.
9. Turn off the signal output of the signal generator and turn the receiver RF GAIN control to maximum.
10. Read the voltage as indicated by the vacuum tube voltmeter connected to prong 5 of the tube socket X-207 and record the value.
11. Set the RF GAIN control to a reading of 9 on the RF GAIN control marking.
12. Turn the signal generator output on and increase the signal generator output level until the voltage indicated by the vacuum-tube voltmeter is the same as that recorded in step 9 above. Record the signal generator output level.
13. Increase the signal generator output level by 3 db. Record the voltage indicated by the vacuum-tube voltmeter.
14. Decrease the signal generator output level to approximately 80 db. below 0.1 volt.
15. Turn the RF GAIN control to maximum.
16. Adjust the signal generator output level so that the voltage as indicated by the vacuum-tube voltmeter is the same as that recorded in step 12 above.
17. Read the signal generator output level. It should not be less than 80 db. below 0.1 volt.
18. If the sensitivity is below that given above, align the receiver by the procedure given in the technical manual, section 4, paragraph 14.

RDZ FRONT END ALINEMENT METHOD

The following method was mentioned in an article which appeared in EIB No. 401. This article stated that a field change incorporating this method would be issued. However, it has been subsequently determined that an official field change is not warranted.

A modification to the RDZ equipment (radio-receiver) permits alinement of the rf section while the receiver chassis is locked in the tilted position. At present, rf trimmer capacitors C-103E and C-103F are not accessible when the chassis is tilted because the bearing plate (left hand, viewed from in front of the receiver) obstructs the access holes in the rf section enclosure. Two new holes, indicated in figure, will permit adjustment of these trimmers without shifting the chassis position during alinement of the rf section. Time can be saved since the repeated alinement and control adjustments sometimes required for optimum results will be easier to perform. Position of the new holes in the bearing plate should be carefully marked to insure alinement with access holes in the rf enclosure, prior to drilling. Manufacturing tolerances and wear in the tilt-locking mechanism may require slight deviations from hole locations shown in the drawing. Careful drilling is essential to prevent metal chips from entering the rf section. Remove all chips after drilling is finished. This modification may be performed, if desired, by the maintenance activity. No official field change will be issued.

ELIMINATION OF SPURIOUS OSCILLATIONS IN RDZ RECEIVERS

Recently the Bureau received a report of spurious oscillations in Radio Receiving Equipments RDZ. Considerable thought had been given to the problem by the originator of the report. The trouble had been located and several methods of correcting the condition had been determined.

The first source of trouble was in the scanning amplifier-circuit, due primarily to the lack of proper termination of the scanning input-receptacle. It was found that by providing proper termination and a shield for the receptacle a large percentage of the interference was eliminated.

A considerable amount of this work could have been eliminated if the maintenance activity had known of Field Change No. 4-RDZ. This field change kit has just recently been made available to all Naval Shipyards and regular stocking activities, and is applicable to all RDZ's.

Additional oscillations were also reported in the fourth and fifth i-f amplifier stages. The causes of this condition are not corrected by Field Change No. 4-RDZ but were found to be as follows:

(1) Filament leads, carrying relatively-high current, laid closely against the tube grid connections, thereby causing coupling and feedback.

(2) Poor grounds of socket clamps of fourth and fifth

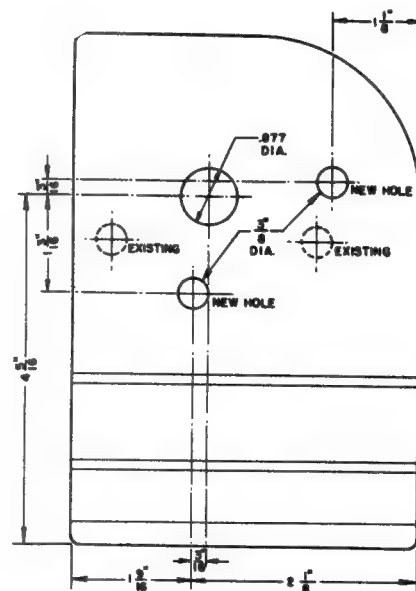


Figure 1

i-f amplifier tubes caused interstage coupling and regeneration.

Condition (1) was corrected by carefully dressing the leads away from the tube base connections.

Condition (2) was corrected by soldering a short lead between the ground lug on the tube socket clamp and lugs No. 1 and No. 3 of the sockets—particularly those of V-205 and V-206.

The Bureau appreciates receiving information of this character, and requests that it continue to flow in.

ADJUSTMENT OF TUNING CAPACITOR END PLATES

Reports have been received by the Bureau of Ships of RDZ radio receivers that have been damaged by attempted adjustment of tuning capacitor end plates. While UHF equipment is especially sensitive to this type of maladjustment, the satisfactory adjustment of tuning capacitor end plates for any type communication receiver requires special information and equipment. **DO NOT TAMPER WITH TUNING CAPACITOR END PLATE ADJUSTMENTS.**

REPAIR OF AUTOTUNE UNITS IN RDZ RECEIVERS

Reports of failure of the autotune unit in RDZ receivers have come to the attention of the Bureau of Ships.

When repair of this unit aboard ship is not possible, making replacement with a spare unit necessary, the defective autotune should be returned to the electronics repair shop (tender or Shop 67 in a shipyard) for repair and return to stock.

CRYSTAL OVENS FOR RDZ, MAR, AND TDZ RADIO EQUIPMENTS

Several failures of the crystal oven, E-121, Navy type CFT-40148, used in RDZ, MAR and TDZ radio equipments have occurred in test and in the field. Activities report that the fine wires connecting the crystal socket to the pin in the oven base break causing an open circuit.

The manufacturer has corrected this defect in all crystal ovens shipped after December 7, 1945. A larger wire is used for the connections.

The ovens can be identified by the color-coding of the two screws on the internal crystal socket. Both screws on the holder in the **old type ovens** are colored a brownish red. In the new improved ovens they are color-coded by the month of manufacture as shown in the following list:

Month of manufacture	Color-Code	
	Screw nearest heater pins	Screw away from pins
Dec. 1945	Red	Blue.
Jan. 1946	Red	Yellow.
Feb. 1946	Red	Green.
Mar. 1946	Blue	Yellow.
April 1946	Blue	Blue.
May 1946	Brown	Brown.
June 1946	Red	Red.
July 1946	White	White.
Aug. 1946	Black	Black.

Crystal ovens of the old type should be returned to the Electronics Officer for replacement with the new improved ovens. Electronics Officers should ascertain that new improved ovens are provided for all RDZ, MAR and TDZ equipments before installation. The spare parts should also be checked for inclusion of the new oven.

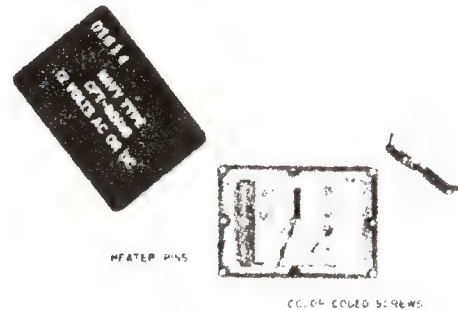


FIGURE 1.--The Crystal oven and the two identifying screws.

RDZ TROUBLE SHOOTING NOTES

Type of failure	Symptoms	Cause
Low emission, shorted, or intermittent	Weak output, no output, or intermittent operation.	Defective tubes.
I-f alignment, r-f alignment, or both required	Weak output or no output	Poor alignment.
Cold oven, broken wires connecting crystal socket to pin, poor connections on oven receptacle, or dirty or poor contacts on S601.	Weak output, no output, or excessive frequency drift.	Defective crystal oven or circuit.
Silencer circuit ungrounded when not using remote units, grounded when using remote or defective resistors.	No silencing action	Silencer circuit inoperative.
Inactive or weak crystals	Weak output or no output on one or more channels.	Defective crystals.
Lubrication or replacement required	Remote dial selected higher channel than desired.	Defective minor switch.
Forms melted or warped	No output or poor i-f selectivity	Defective i-f coil forms. Accomplish F. C. No. 7-RDZ
Armature misadjusted or coil shorted	Autotune motor ran continuously.	Defective relay K106 in Navy Type CQC-23497.
Broken ceramic shaft or broken coupler on Autotune Unit.	No output and no tuning	Faulty coupling between Autotune unit and tuning capacitor.
Bent pins or pin holders on sockets	Intermittent operation	Poor connections between tube pins and sockets.
Fuse missing or open	No output	Defective fuse.
No Panoramic Adapter or dummy load plugged into J403.	I-f oscillation present	Improperly terminated SCAN Jack J403.
Open control or poor contact or rotor	Noisy output when control was turned, or intermittent operation.	Defective RF GAIN control.
Loose coupling with excessive play, or damaged linkage.	Poor i-f selectivity	Faulty linkage between IF BAND control shaft and i-f transformers.
Lock nut not tightened sufficiently	Dial failed to indicate proper frequency.	Loose lock nut on tuning dial.

RDZ SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Lcw sensitivity.
Low-audio output.

Autotune motor runs continuously.

Intermittent operation on one channel only.
Greatly reduced sensitivity when i-f band switch is in "sharp" position.

No silencer action. High noise level.

Cause and Remedy

Check 6AB7 i-f tubes. Replace if required and realign.

(1) Broken antenna plug. (2) Low emission of r-f amplifier tube type 956. (3) Realign completely.

Relay K-106 of 23497 selector control unit out of adjustment.

Rosin joint on crystal oven receptacle.

Check for failure of crystal oven. It should be hot.

Traced trouble to open circuit in remote squelch relay circuit. Found open circuit in remote control plug at rear of receiver. Cleaned and tightened plug which then resulted in proper squelch action consequently low noise level. Receiver was in otherwise good operating condition.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****RT-66/GRC
REPLACEMENT OF CAPACITOR**

Information received from the Signal Corps disclosed that capacitor C-303 was changed from 220 mmf to 470 mmf in later production models of Receiver-Transmitter RT-66/GRC in order reduce RF volt-meter sensitivity when used in their application with short antenna transmission lines.

In Navy installations, the antenna transmission lines are necessarily longer length. The increased capacity of the

coaxial transmission lines therefore, unbalances the RF voltmeter circuit, causing a reduced meter sensitivity.

Replacing capacitor C-303 with one rated at 220 mmf to increase meter sensitivity is approved, providing the increased sensitivity does not cause an off-scale reading when the transmitter is tuned over the entire frequency range of the equipment.

ORIGINAL**RT-66/GRC:1**

NEW SWITCH SHAFTS

The phenolic switch shafts of the SB-82/SRR receiver-transfer switchboards have been breaking, usually during installation. As a result, the Bureau has redesigned this shaft. The new shaft is of brass with a phenolic cam. These new shafts have been delivered and are available at ESO, Great Lakes, under stock number N16-2-2650-3. Activities installing these switchboards should keep a supply of the new shafts on hand. New panels under procurement will be furnished with the new type shafts installed.

MOUNTING AND WIRING

Cabling and wiring to the SB-82/SRR and SB-83/SRT may become a complex problem when these switchboards are mounted between a ship's frames. Side entrance of cables presents special cable routing problems. Figure 1 shows a neat method of installation for these switchboards, especially when they are to be mounted on a vessel which requires only one or two.

First, remove the bottom cover plate of the transfer switchboard and fabricate a sheet metal box the same width as the board. It should have enough depth to extend back of the box for accommodating the installation of cable terminal tubes or connectors. Next, cut a hole in the top of the box the same size as the existing hole in the bottom the transfer board. Drill holes in the box for attaching it to the bottom of the transfer panel by using the existing holes which held the original bottom cover plate. In addition, cut a hole in the front of the box and drill it to accommodate an access over plate.

This will provide entry for installing any necessary terminal tubes or connectors and will allow for arranging of conductors. Cables can be brought into the box from a straight run, either from the bottom or the top.

SB-82/SRR

Reports from the field state that screws, washers, bits solder, and other foreign matter are often found lodged in the switches and wiring of the Radio-Receiver, Transfer Switchboard, SB-82/SRR. The following is based on an engineers work report which describes the inspection of the SB-82/SRR at one installation:

Conditions Found:

Numerous conditions that could cause crosstalk.

Cause:

Numerous metal objects across the terminals, knobs incorrectly mounted, knobs missing on switches, no cable clamps on main audio patch panel for all external cables coming into the panel.

Corrective Measures:

Checked all vertical and all horizontal rows of switches on this panel for grounds and shorts between

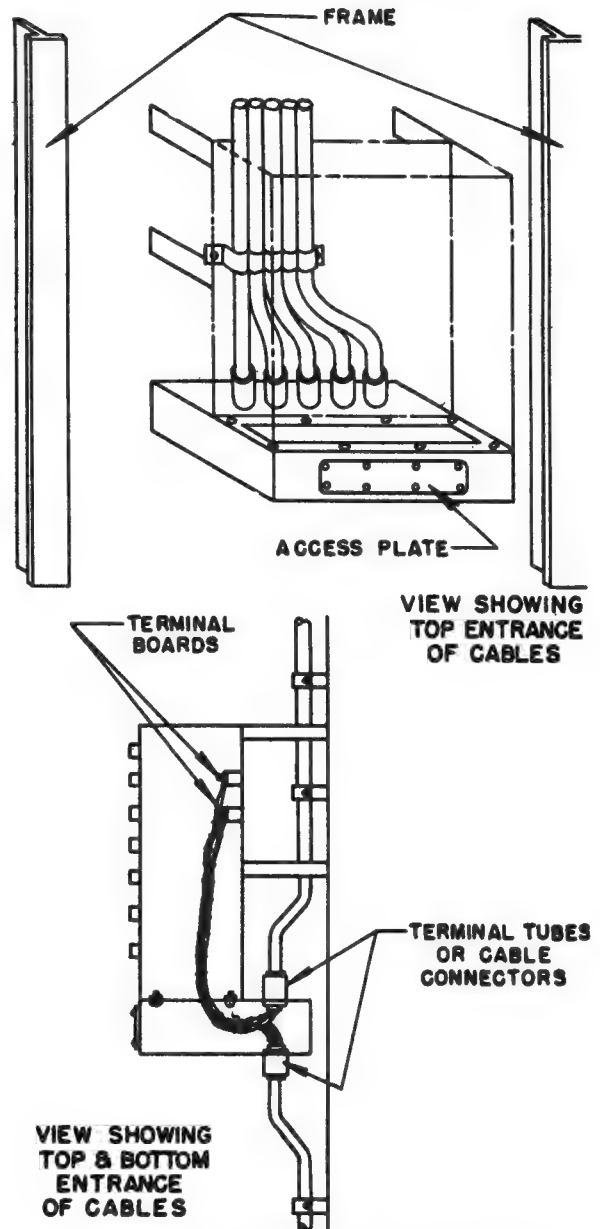


FIGURE 1. Modification of Switchboard.

switch rows running in either direction. Cleaned out the parts found in the panels such as loose nuts, bolts, washers, and solder sprayed on the terminals. Readjusted the knobs on the switches as required to prevent shorts between adjacent circuits. Replaced missing knobs. Tried different combinations to see if cross talk still persisted and could find none. (This included combinations which the ship had trouble with before.)

Remarks:

Most of the trouble could have been prevented if the bolts and solder drippings were found directly across terminals. These bolts were mostly 5/16-inch by 1-inch, or longer; and there were 15 to 20 in the panel along with numerous pieces of solder, nuts, and lock washers. No cable clamps were used to bring external cables into the panel, and it is recommended that cable clamps be put on as soon as possible to prevent fraying and future trouble. The scope of the job of supplying cable clamps requires the assistance of a Navy Yard. Also, it was observed that when switch knobs were mounted toward the end of the switch shaft, the knobs could be pushed in far enough to make contact without turning the switch. Where switch knobs were missing, the switch shaft could be pushed in to make contact in the same manner. (This is not true of all switches but approximately one third of them do make contact when these conditions exist.) On two switches, the knobs were mounted 90-degrees from the correct position on the shaft, consequently, it appeared that the switch was off when it was actually connecting two circuits together.

The exercise of greater care during installation of the equipment and a thorough inspection after the job is completed will reduce or eliminate the conditions reported. The use of a small drop cloth to cover the wiring mat when the front panel is open during installation should prevent solder and small parts from entering the wiring mat. Inspection of existing installations during routine maintenance may also prove of value in reducing crosstalk and malfunctioning of equipment.

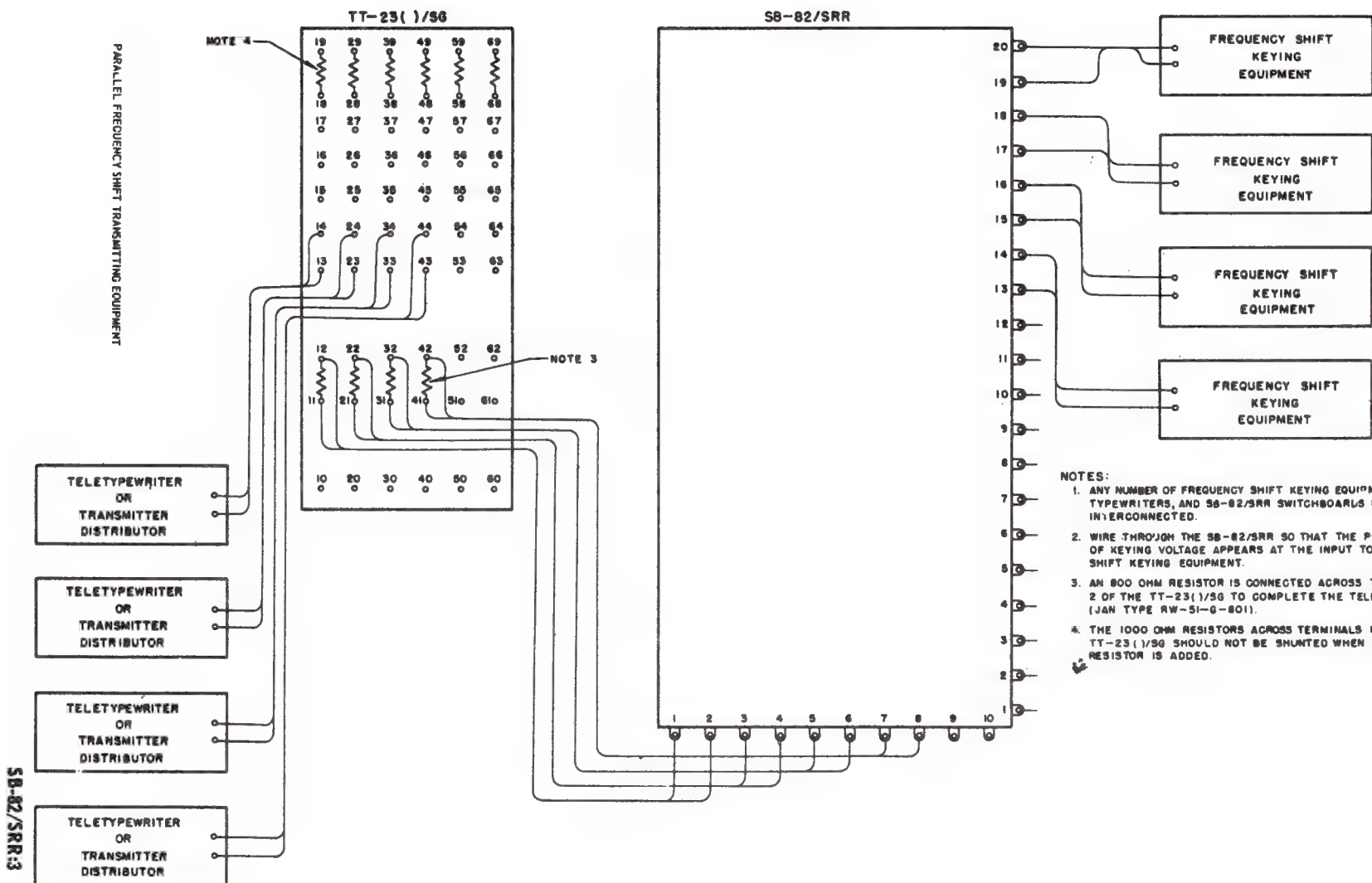
INSTALLATION OF NAMEPLATES ON TRANSFER SWITCHBOARDS

The following beneficial suggestion proposes that the nameplate strips associated with SB-82/SRR Transmitter-Transfer Switchboards, identifying stations, or positions, be engraved on every other vertical strip. Those nameplates identifying equipments be engraved on every third horizontal strip when the switchboards are mounted in the vertical position. Likewise, the nameplate strips used with the SD/82/SRR Receiver-Transfer Switchboard could be engraved on every other switchboard in the vertical and horizontal direction for identification of equipment and stations.

This method of identification eliminates 50% of the engraving now used on every nameplate on each switchboard installed. In addition, a saving of material will be realized since nearly 50% of the blank nameplate supplied will be available for engraving in event changes are desired on the switchboard.

In view of the above savings, the Bureau recommends that installing activities follow the procedure outlined above in future installation of this equipment.

This will provide entry for installing any necessary terminal tubes or connectors and will also provide for conductor arranging. Cables can be entered into the box from a straight run, either from the bottom or the top.



NONCONFORMITY OF SWITCHBOARDS

The SB-83/SRT equipments have been procured from numerous sources. San Francisco Naval Shipyard has reported that those supplied under Contracts NObsr-52024 and NObsr-57241 do not conform mechanically with the others in that the switch rows are 5/8-inch below the specified level.

This discrepancy becomes apparent when Field Change panels had been cleaned when they were installed. Numerous 1-SB-83/SRT is accomplished. The horizontal rows of switches must be in alinement on successive switchboards to install the field change, which necessitates remounting the switchboards if some are of the non-standard type. This disrupts the top and bottom lines of the installation and complicates mounting.

It is recommended that the switchboards bearing the Contract numbers NObsr-52024 and NOsr-57241 be grouped prior to installation and mounted together and not intermixed with those supplied under other contracts. In addition, make a thorough inspection of all switchboards (especially those supplied under Contract NObsr-52024) prior to installation to insure the absence of faults such as cold

solder joints, frayed or insufficient insulation, and lack of continuity.

MOUNTING AND WIRING

See article in SB-82/SRR under same title.

APPROVED METHOD OF TESTING SB-83/SRT AND SB-82/SRR TRANSMITTER AND RECEIVER TRANSFER SWITCHBOARDS

An approved method of testing SB-83/SRT and SB-82/SRR, transmitter and receiver-transfer switchboards, was submitted.

It was suggested that shipyards fabricate a portable testing apparatus that could quickly check the completed wiring of receiver-transmitter transfer switchboards installed aboard ship. Interested shipyards may request the fabrication drawing (RE 60F 2046) SB-82/SRR and SB-83/SRT transmitter, or receiver switchboards test equipment, from the Bureau of Ships.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****CONTROL PANEL, TELEGRAPH KEY SB-315()/U INSTALLATION PROCEDURE**

During a recent ship insurv trial attended by a Bureau of Ships representative, it was noted that the Control Panel, Telegraph Key SB-315()/U was improperly installed. The SB-315 ()/U had been installed in the proper location, but the mounting hole in the radio-operating position had not

been enlarged sufficiently to allow proper recessing of the complete panel. The installation noted placed the key assembly at an inconvenient height which caused operator fatigue.

Activities installing the SB-315 ()/U shall locate the control panel so that the phenolic panel is mounted flush with the operating position mounting surface.

ORIGINAL**SB-315/U:1**

SERVICE NOTES**NAYSHIPS****900,000.1****COMMUNICATIONS****ANTENNA HINTS**

Antenna Transfer Panel SB-346/S, shown in BUSHIPS drawing No. RE 49F 680, is mounted in an aluminum box. No provision (mounting holes, lugs, etc.) has been made for installing this unit aboard ship because each installation may be made under slightly different conditions.

When an SB-346/S is to be installed, the aluminum box (part 3, RE 49F 680) should be removed and drilled for bolts, or mounting lugs should be attached. After the box is prepared for installation, it should be inspected for chips, burs or other faults before actual reassembly and installation.

REPLACEMENT OF SWITCH WAFER, SYMBOL E-307

Two Rotary Relays are available for replacement of Symbol K-302 in equipment models SB-440/SP, SB-441/SP and SB-442/SP.

They are as follows:

N5945-539-2068 Admiral Part No. 591C5-1 Leland
Drawing No. B-62471-A

N5945-601-1004 Admiral Part No. 591C12-1 Oak Mfg.
Co. Part No. RS-51393

Each of these Rotary Relays is stamped with the Admiral Part Number and is, as a unit, physically and electrically interchangeable with the other.

In case of failure of the Switch Wafer (E-307), it will be necessary to check the Admiral Part Number stamped on the mounting plate of the Rotary Relay (K-302). A replacement Switch Wafer, under stock number N5930-621-8882, is available for the Rotary Relay, Admiral Part No. 591C12-1, but no support has been given the Switch Wafer used with the Rotary Relay, Admiral Part No. 591C5-1. Failure of E-307 on K-302 with Admiral Part No. 591C5-1 will necessitate the replacement of the entire Rotary Relay.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****SB-467/FG AND SB-470/FG PATCHBOARDS (SHORE)**

Navy activities ashore using standard patchboards SB-467/FG (teletype) and SB-470/FG (audio) may clarify the designation of SEND/RECV, LINE/LINK, RADIO/WIRE channels by replacing the clear designation covers (face strips) with interchangeable colored designation covers.

These are available in ESO stock as follows:

For 1/4" designation strips, such as WE99A

Face Strip, clear
Face Strip, amber
Face Strip, green

N9330-321-6889
N9330-505-4179
N9330-505-4173

For 1/2" designation strips, such as WE99B

Face Strip, clear
Face Strip, amber
Face Strip, green

N9330-321-6888
N5820-693-3957
N5340-693-5321

Reference: BUSHIPS INST 10550.56A CH 1 of 24
January 1958

SCR-299 TROUBLE SHOOTING NOTES

Difficulty Encountered

SCR-299.—Antenna tuning unit Signal Corps type BC-720 of radio set SCR-299 is not satisfactory for use with long wire antennas.

SCR-299.—Frequent failures of transformers and reactors, due to moisture absorption.

SCR-299.—Failure of electrolytic capacitors C-20 and C-21 in radio transmitter BC-610.

SCR-299.—Radio interference, which may result from ventilating fan circuit.

SCR-299.—Leakage between B + and a-v-c circuits on common terminal board, under humid conditions.

Cause and Remedy

An auxiliary long wire antenna has been furnished beginning with SCR-299-(C), and Signal Corps technical manual TM11-280 and TM11-281 give instructions for its use.

Replace with hermetically sealed replacement components.

Use an 8-mfd. 600-volt paper capacitor for this circuit.

Investigation determined that the addition of a 0.5-mfd. automotive suppression type capacitor, connected between the fan "hot" terminal and ground, would effectively suppress the reported radio interference. This leakage can be corrected by relocating connections to the terminal board. Data for field modifications is being assembled.

SCR-300 TROUBLE SHOOTING NOTES

Difficulty Encountered

SCR-300.--Mechanical failure of flexible gooseneck of antenna AN-130-A.

SCR-300.--Inadequate carrying method for radio set SCR-300 which tires personnel.

SCR-300.--Failure of antenna AN-130-A due to breakage of the base shell.

SCR-300.--Insecure fastening of tube shields of radio receiver and transmitter BC-1000.

SCR-300.--Breakage of trunk catches holding chassis and battery cases together.

SCR-300.--Insufficient clearance between B-plus lug on coil L-3 and chassis, resulting in water grounding B-plus lug to chassis, causing resistor R-6 to burn out.

Cause and Remedy

Tests show that the failure of the gooseneck is not due to a weakness in the material used for its construction, but rather to the method of fastening the gooseneck to the base bushings. It has been determined that an external spring covering the joint of the gooseneck and the base shell bushing will considerably improve the gooseneck's resistance to breakage. Signal Corps nomenclature AN-130-B has been assigned to the antenna incorporating the reinforced spring. Current procurement of antennas for replacement purposes will require antenna AN-130-B.

The standard Army quartermaster pack board can be utilized. A light-weight model of SCR-300 has also been developed. The pack board is obtainable, through channels, from the Marine Corps.

A stronger base shell is now being manufactured. Procure through regular channels.

During initial production, the tube shields were too tight and contributed to the excessive tube breakage experienced with early sets. The loose tube shield is a compromise solution of the problem. It is believed that the tube shields in current production are adequately secured.

Signal Corps modification work order MWO SIG 11-242-2, dated 20 November 1944 details instructions for replacing original catches with catches of a strong mechanical construction. Procure these modification work orders through channels. Production changes are now being made.

Manufactures are providing, on all future models, additional clearance by proper dressing of lug.

DPST SWITCH IMPROVES SCR-300 TRANSCEIVER

Installation of a DPST switch to lengthen battery life in SCR-300 transceivers has been suggested by Martin G. Levitt of the New York Naval Shipyard.

A number of SCR-300 transceivers are used for passive defense and must be kept ready for emergencies with batteries installed. The transceivers have BA-70 batteries equipped with an on/off switch SW2. In the off position, only the filament voltage is broken. The B+, 90V, and 60V voltages remain connected with the associated circuits.

As a result, the shelf life of the batteries was less than half the normal expectancy, and lowered voltages were causing poor transceiver operation. Tests were made by inserting a milliammeter in the (B) supply. It was discovered that 10 milli-amperes was being drawn from the battery, through leakage of bypass condensers, with the unit stored in off position.

Substitution of a DPST switch for the SW2 switch was proposed. Additional wiring was installed to permit the B voltage to be turned on/off simultaneously with the filament voltage by breaking the B-lead with the second section of the switch.

With this system, there is no drain on the battery when it is not in use. Therefore, excessive battery replacement is eliminated, and the transceivers are in top operating condition whenever they are needed.

INFORMATION ON SCR-508 AND SCR-608 RADIO TRANSMITTING-RECEIVING EQUIPMENTS

SCR-508 and SCR-608 radio transmitting-receiving equipments have been widely distributed for shipboard installation. This article is published for general information and guidance in connection with the installation of these equipments.

Components	SCR-508	SCR-608
Transmitter	BC-604	BC-684A
Receivers	2-BC-603	BC-683A
Mounting	FT-237	FT-237
Antenna	Whip	Whip
Mast base MP-48A		
Mast sections MS-51, MS-52, MS-53.		

The basic unit of the SCR-508 and SCR-608 is packed with the above components and other miscellaneous accessories, except mast section MS-51.

Navy Installation Unit.

In addition to the basic unit the equipments procured for shipboard use are now being shipped with an additional package designated the Navy Installation Unit, U. S. Army Signal Corps, Stock No. 2S508-NA/50, which contains additional accessories such as headsets, microphones, and mast section MS-51.

Power Supply:

The SCR-508 and SCR-608 sets for shipboard installations are to operate from 12 volts dc. The plate voltage is obtained from self-contained 12-volt d-c input dynamotors.

Storage batteries will have to be supplied to operate these equipments on ships where the required voltage is not available, until such time as auxiliary power units become available.

Auxiliary power units under procurement to operate the SCR-508 and the SCR-608 are as follows:

Dynamotors: 115/230-volt d-c input and 12-volt d-c input, 500 watts output.

Motor-Generators: 115-volt d-c input and 12-volt d-c input, 500 watts output.

References:

War Dept. Technical Manual for SCR-508, TM-1-600

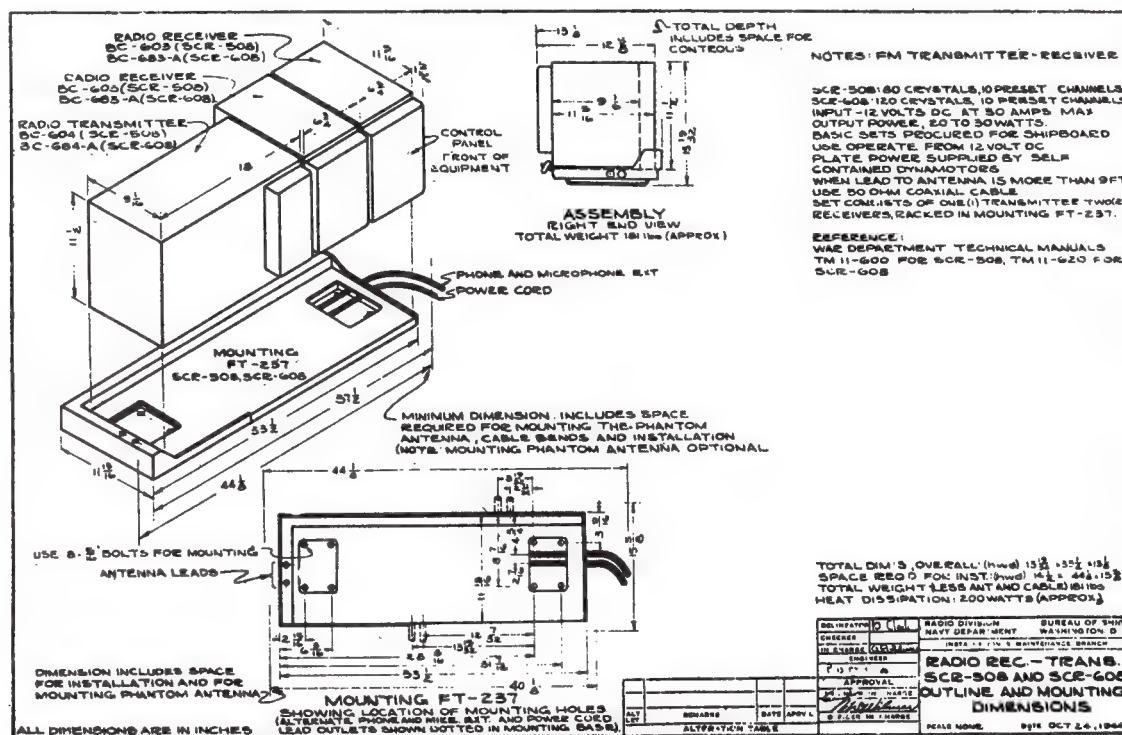
War Dept. Technical Manual for SCR-608, TM-11-608

Type Installation Plan for Model SCR-508 and SCR-608, BuShips Dwg. RE43F334B.

BuShips Dwg. RE 43AA 426A reproduced as Figure 1 for additional detailed installation data.

INTERFERENCE BETWEEN SCR-508, SCR-608, SCR-610, AND SCR-808 EQUIPMENTS

The Navy Radio and Sound Laboratory, San Diego, California, has made an investigation of interference



between SCR-508, SCR-608, SCR-610, and SCR-808 equipments and has found that the main source of interference is radiation at transmitter-harmonic frequencies resulting in interfering signals on several channels of receivers connected to adjacent antennas. Other interference are due to image response.

Field modification of these equipments to eliminate this interference is not practicable and therefore should not be tried by field activities.

It is recommended that frequency plans be laid out and tested with actual equipments in order that interference between channels may be detected and corrected. Maximum separation of antennas is also of value in reduction of interference.

MODIFICATION TO ADAPT SCR-508, SCR-608, AND SCR-808 TO SHIPBOARD MOUNTING FOR AMPHIBIOUS OPERATION

To increase the usefulness of the models SCR-508, SCR-608, and SCR-808 radio equipments in amphibious operations, it has been found desirable to operate the two receivers independently, in order that only one would need be disabled when the transmitter is working.

This modification, Figure 1, allows one receiver to operate on the transmitter frequency and the other receiver to operate as a standby receiver. Two antennas, therefore, are needed. The standby receiver, with its own antenna, must necessarily be set on frequencies different from those used by the transmitter and will guard one of these additional frequencies. The operating receiver is disabled and the antenna is automatically transferred to the transmitter when the latter is keyed. The standby receiver is not disabled. The single-pole double-throw toggle switch permits the transfer of the audio from either operating or standby receiver to the various remote stations.

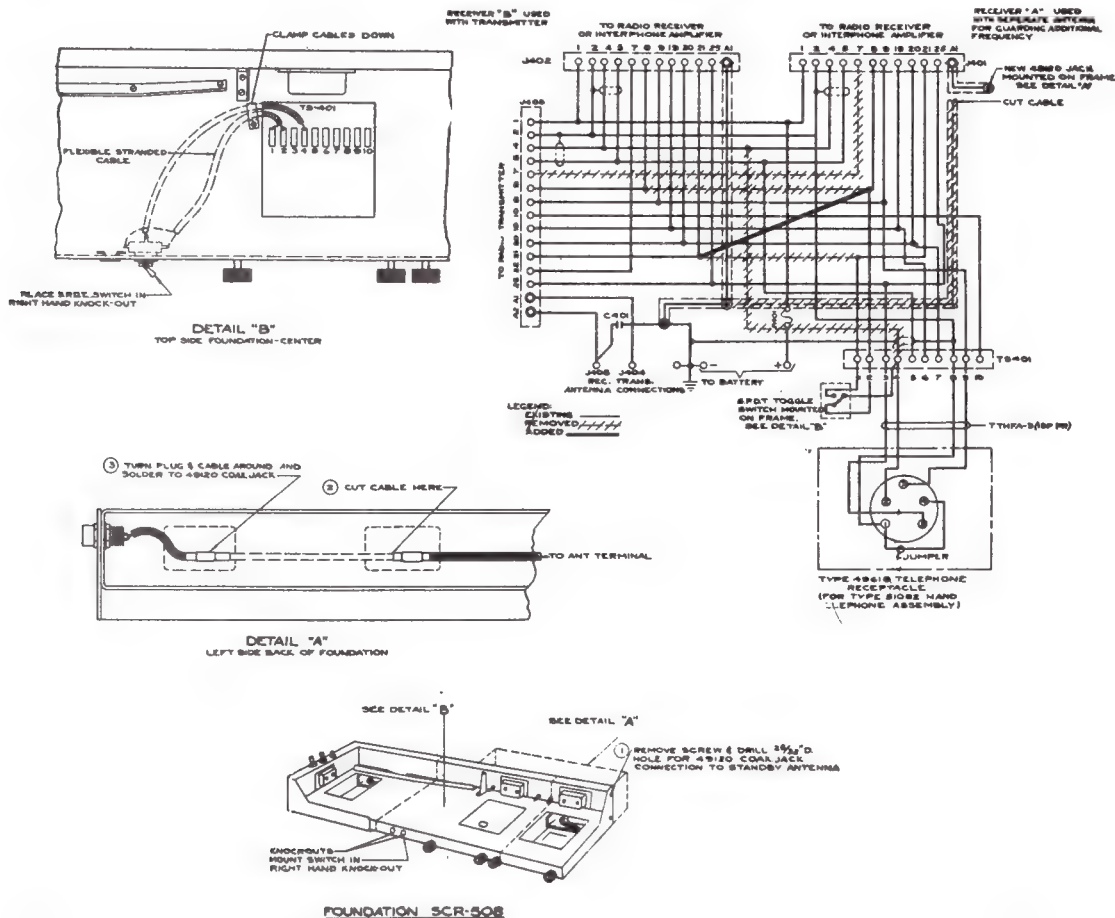
The following recommendations are forwarded:

(1) One additional antenna should be installed for each SCR-508, SCR-608, and SCR-808.

(2) One antenna should be connected to the transmitter and one receiver; the second antenna should be connected to the other receiver, which will serve as a standby receiver.

(3) The mounting base Signal Corps type FT-137, common to each type equipment mentioned, should be modified so that each receiver can be operated on headphones independently.

The accompanying circuit diagram shows the changes required. The bureau desires that these modifications be



made in equipments installed in new construction vessels by the cognizant Radio Material Officer either prior to the delivery of the vessel or during the outfitting period. Ships having qualified technicians are authorized to make similar modifications on equipments already installed in vessels of the amphibious force.

The necessary procedure of modifying Signal Corps mounting type FT-237 for receiver audio selection is outlined below.

(1) Remove lead (white with red-brown tracer) between receiver A connection receptacle J-401, pin 7 and transmitter connection J-403, pin 7.

(2) Remove lead (white with red-green tracer) between J-403, pin 21 and J-401, pin 21. Retain lead (white with red-green tracer) between J-401, pin 21 and mounting plate terminal strip TS-401 terminal 1.

(3) Clip lead (white with brown tracer) between receiver B connection receptacle J-402, pin 8 and terminal strip TS-401, terminal 2. Splice this lead to the lead remaining on J-402, pin 21 (white with red-green tracer) so there is continuity between J-402, pin 21 and TS-401, terminal 2.

(4) Mount the single-pole double-throw toggle switch in right-hand "cable knock out" on front of mounting FT-237.

(5) Connect TS-401, terminal 1, to one side of the switch and TS-401, terminal 2, to the other side of the switch. Clip and tape lead on TS-401, terminal 4, and run a lead between this terminal and the pole of the toggle switch.

(6) Signal Corps Technical Manual TM 11-600 for radio sets SCR-508, SCR-528, and SCR-538 will be very helpful in making these modifications.

These modifications are necessary so that each receiver can be used independently of one another, with one permanently acting as a standby receiver to continuously guard the frequency to which it is assigned. These three models, SCR-508, SCR-608, and SCR-808 were originally designed for vehicular mounting and only required one antenna. The sets were so designed that **both** receivers were disabled when the microphone push-to-talk button was depressed (to transmit). Without the above modification, incoming traffic on **both** receivers is lost whenever the transmitter is being used.

All antennas should be placed as clear of metal screens or masses as practicable in order to avoid shadow and directional effects. Mount receiving whips in the clear as far forward as practical. Mount transmitting whips in the clear as far aft as practicable. A minimum of twenty feet between receiving and transmitting antennas is necessary for minimum interference. Tests should be conducted on each vessel prior to permanent installation of antennas to determine the most suitable locations. Temporary coaxial cable may be run from the permanent location of the radio equipment to the various antenna locations for test purposes. The antennas used on these installations should be separated both horizontally and vertically as far as practical. The receiver antenna should be the higher of the two. Ship's personnel should conduct tests to determine whether two

or three section whips should be used for transmitting and receiving antennas.

Antenna mountings Signal Corps type MP-48-A have been forwarded to Radio Material Officer activities to meet requirements of the additional whip antenna installations.

Beginning March 1945, this extra MP-48-A mounting base will be included in the Navy Installation Unit Signal Corps stock number 2S508-NA/50.

The antenna used with these equipments is a nine-foot fishpole sectional mast type and is composed of mast sections Signal Corps types MS-51, MS-52, and MS-53. Mast section MS-51 is the top and smallest section. One of each type mast section is provided with the basic equipment, when first procured.

The Commander Amphibious Force, U.S. Pacific Fleet has provided information to Bureau of Ships on a somewhat similar modification. This modification, described in an article entitled "Modification to Permit Independent Operation of the Receivers of Models SCR-508, SCR-608 and SCR-808 Radio Equipments" and previously published in this bulletin and deleted with this supplement, also required two antennas. One antenna is connected to the Transmitter. The second antenna is connected to the receivers only. This modification is a less satisfactory modification than the one described in this article for the following reasons: As originally designed, the receivers and transmitters used a common antenna. The receiver disabling relay was energized when the microphone button was pressed, which short-circuited the output of both receivers. Simultaneously, the antenna transfer relay was energized and its contacts transferred the antenna from the input of both receivers to the transmitter output. When the modification, as recommended by COMPHIBPAC, is affected, the antenna transfer relay no longer performs a transfer function. This means that the receiver or receivers which are operating on the same frequency as the transmitter will have the transmitted energy loaded into the receiving antenna and endanger the first r-f stage as the disabling relay shorts the audio output only. The COMPHIBPAC modification is excellent, but requires alert operators, if the burning out of the first r-f transformer, etc., and the continual shutting down of the operating receiver is to be avoided. The New York modification, once installed, is automatic and the "master" frequency is always open to incoming signals when the transmitter is not being used.

INSTALLATION OF RESISTORS IN SCR-508 RECEIVERS

Several SCR-508 receivers have come through without resistors R-22, R-32, and R-33 in the headphone audio output circuit.

Investigation discloses that the Army has removed the three parallel resistors in this circuit in order to increase the audio headphone output. Since in Naval installations loudspeaker is used as well as phones, activities concerned are authorized to install a resistor or resistors equivalent to 10,000 ohms at 1½ watts in place of resistors R-22, R-32, and R-33 if they have been removed.

INFORMATION ON SCR-509, SCR-510, SCR-609 AND SCR-610 RADIO TRANSMITTING-RECEIVING EQUIPMENTS

SCR-609 and SCR-610 radio transmitting-receiving equipments are now being widely installed on shipboard. This article is published for general information and guidance:

Component	SCR-509	SCR-510	SCR-609	SCR-610
Trans-Rec	BC-620	BC-620	BC-659	BC-659
Battery case	CS-79	CS-79	CS-79	CS-79
Antenna (whip)	AN-29-C	AN-29-C	AN-29-C	AN-29-C
Plate power supply		PE-97 or PE-120		PE-117 or PE-120
Mounting base		FT-250		FT-250
Antenna		Whip		Whip
Base MP-48A				
Sections MS-51, 52, 53.				

The basic unit of these sets comes packed with the above components and other miscellaneous accessories.

Navy Installation Unit

In addition to the basic unit the sets procured for shipboard used are now being shipped with a second package designated the Navy Installation Unit, U. S. Army Signal

Corps, Stock No. 2S510-NA/50, which contains additional miscellaneous accessories such as headsets, microphones and vibrators.

Power Supply Units:

PE-97 and PE-117, input 6 or 12 volts DC. Linkages are provided on the sets to connect for desired input voltage.

PE-120, input 6, 12 or 24 volts DC. The proper vibrator has to be inserted in the set to operate at the desired input voltage.

All basic sets now being shipped are to operate from 12 volts. The Navy Installation Unit contains the additional 6- and 24-volt vibrators.

Power Supply:

Storage batteries will have to be supplied, to operate these sets on ships where the required voltage is not available until other auxiliary power units become available.

Rotary equipment to operate these sets from a 115-volt d-c source is expected to be available. This unit is a dynamotor with an input of 115 volts DC, and with 150 watts output at 12 volts DC.

Dry batteries to operate the SCR-509 and SCR-609 are Stocked by Supply Officer for Radio at Navy Yards Mare Island, New York, and Norfolk, and May be requisitioned through the regular channels.

References:

War Dept. Technical Manual for SCR-510, TM-11-605.
Ware Dept. Technical Manual for SCR-610, TM-11-615.

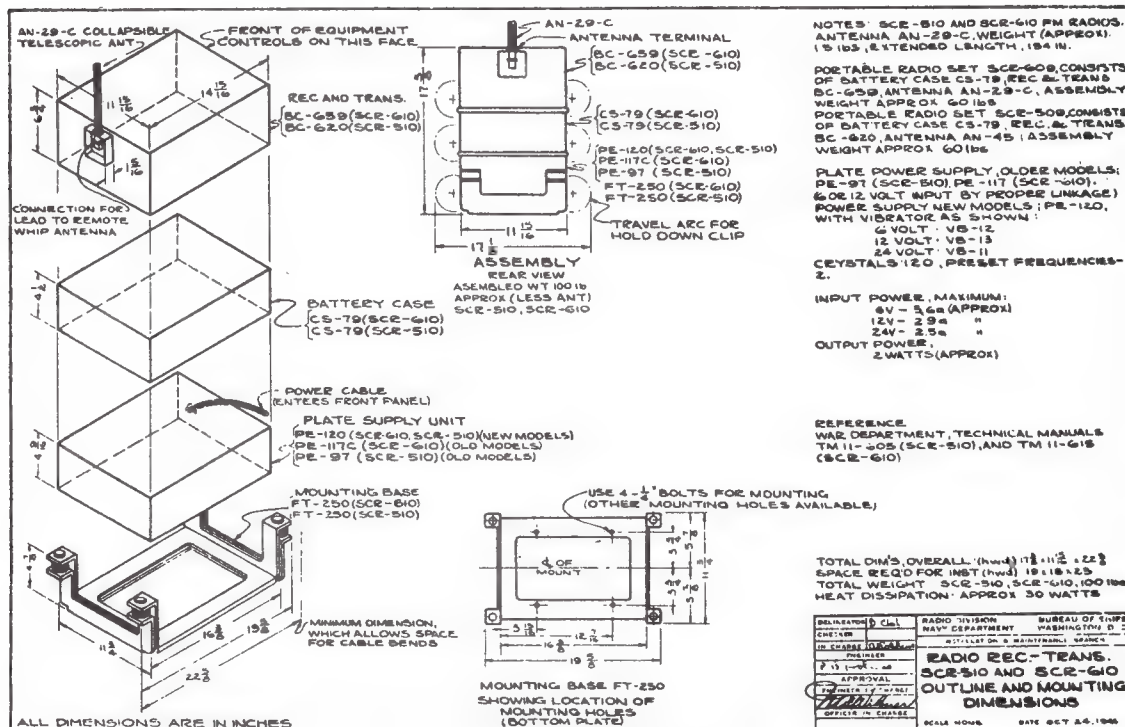


FIGURE 1.--Installation data for models SCR-509, SCR-510, SCR-609 and SCR-610

COMMUNICATIONS**NAYSHIPS****900,000.1****SERVICE NOTES**

Type Installation Plan for SCR-610-BuShips Dwg.
RE 43F 333B.

BuShips Dwg. RE 43AA 424A reproduced as Figure 1 for
additional detailed installation data.

SCR-509 TROUBLE SHOOTING NOTES**Difficulty Encountered**

SCR-509.—Destruction of Loudspeaker cones by concussion of nearby gunfire.

Cause and Remedy

A manually operated loudspeaker shutter will be incorporated in future production of BC-659-H. This shutter may be requisitioned and installed in the field.

ELIMINATION OF NOISE AND POOR OPERATION IN SCR-522 EQUIPMENTS

The following expedients have successfully eliminated noise and improved reception in SCR-522 transceivers:

- (1) The coaxial shield of the antenna transmission line was soldered at both ends to the connectors.
- (2) Paint was removed from around the mounting holes under the junction box to assure a good ground connection.
- (3) Paint was removed from around antenna insulating base.

SCR-522 TROUBLE SHOOTING NOTES**Difficulty Encountered**

SCR-522.--Power-amplifier plate choke (r-f reactor, circuit reference No. 128-3, Signal Corps stock No. 2C6525A/R3) in the transmitter (Signal Corps nonenclature BC625A) burned out.

Cause and Remedy

The cylindrical-shaped phenolic insulator, that insulates the antenna coupling inductor (circuit reference No. 122, Signal Corps stock No. 2C6525A/J10), worked loose from the coupling inductor. When the thumbscrew was turned counter-clockwise, the phenolic insulator was also turned from two to four turns off the inductor, thereby causing a short from the antenna coupling to the power-amplifier plate inductor when the thumbscrew was tightened.

This failure was remedied by removing the antenna coupling control thumbscrew completely. The phenolic insulator was then screwed from six to eight turns counter-clockwise and Glyptol cement was applied to the threads of the antenna coupling inductor. The phenolic insulator was next screwed down tight and the cement was allowed to harden for one hour. Finally, the thumbscrew was replaced. The equipment has given no further trouble in tuning.

SCR-608 TROUBLE SHOOTING NOTES**Difficulty Encountered**

SCR-608.--Very low percentage of modulation when operating from local position.

SCR-608A.- -Relays S-101, S-102 and S-103 were lagging when microphone button was released.

Cause and Remedy

Due to remote microphone being in parallel with local microphone. Rearranged switch contacts in remote control to disconnect remote microphone when not in use.

Found remote control cable to be grounded in box on bridge. Cleared ground, cleaned relay contacts and all O.K. again.
O. K. again.

RECEIVER TUBE PROTECTION IN SCR-610 RADIO EQUIPMENTS

When removing receiving tubes from the SCR-610 be sure that the power is off. The filaments of the receiving tubes are all hooked in parallel, in series with an Amperite tube 10T1, as shown in figure 1. If more than three tubes are out of the circuit when the power is applied, the rest of the tubes will almost certainly be damaged. Without the proper number of tubes, there is not enough current to give the correct voltage drop across the Amperite tube, leaving too much voltage across the receiving tube filaments.

REMOVE AND DISCARD DESSICANT

It has suggested that the dessicant bags be permanently removed from the SCR-610. He states that this measure will save repairs on the equipment since the bags, if not properly maintained, defeat their purpose by releasing the accumulated moisture into critical areas of the equipment.

Since the harm done by over-saturated dessicants can be much greater than the benefit derived from properly maintained units, remove and discard the Silica Gel bags fastened inside the equipments. The SCR-610 is obsolescent and will be replaced in the near future so no field change will be issued.

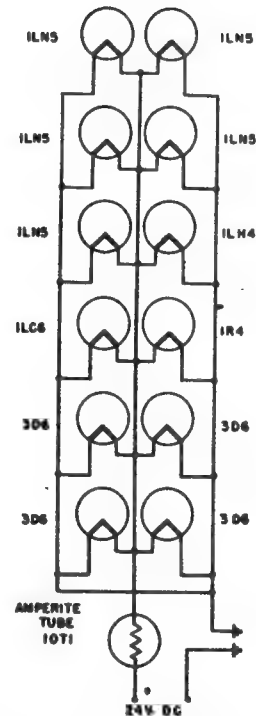


FIGURE 1. Receiver filament circuit.

SCR-610 TROUBLE SHOOTING NOTES

Difficulty Encountered

SCR-61.--Continually blew line fuses.

Cause and Remedy

Faulty voltage regulator tube VT-195, and a shorted filter condenser, C-403, were discovered. These were replaced and the set operated normally.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****FAILURE OF CAPACITORS IN SCR-624 RADIO EQUIPMENT**

A relatively large number of failures of capacitors used in SCR-624 radio equipment has been reported. Investigation discloses that many of the defective capacitors are paper. These capacitors gather moisture and, after an

idling period, fail more rapidly. In some cases the capacitor failure will result in other components becoming defective, and conditions will arise which makes shipboard repair very difficult.

When failures of these capacitors occur, they should be replaced with either mica or ceramic type capacitors. All vessels and activities should be on the alert for failures of this type.

SCR-624 TROUBLE SHOOTING NOTES**Difficulty Encountered**

SCR-624.-- The by-pass capacitor, symbol No. 102-1, 6800 mmf. 300 V DCW has been reported as failing.

Cause and Remedy

Replace 102-1 with a mica capacitor, 6800 mmf. 600 V. DCW Navy type CM 45 B682K.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****SG-354/U--ANTENNA AND TRANSMISSION LINE
CHECKER, AVAILABILITY OF**

Bureau of Ships has under procurement antenna checkers in the flashlight form factor. These checkers are commercial equipment made by Thompson-Ramo Wooldridge. They are to be requisitioned from stock through regular supply channels. Nomenclature has been assigned as SG-354/U. The RF output below 1000 mc is 25 db minimum above 1 microvolt per megacycle bandwidth as measured with an Empire Devices Corporation model NF-105 Noise Intensity Meter, using an antenna-to generator spacing of 50 inches. Above 1000 mc the R.F. output is 500 microvolts minimum as measured with a Polarad Model TSA Spectrum Analyzer, using an AT antenna spaced two (2) inches from the checker.

The flashlight checker employs an 18 volt dry cell battery. Battery life is about 50 hours, based on 10 minutes operation per day. A battery is supplied with each equipment.

The output signal level of the flashlight shaped antenna checker cannot be guaranteed from unit to unit or over any period of time. The output is subject to deterioration due to aging of the battery and the interference generator head. Therefore this instrument should be considered as a rough go-no-go signal source rather than a calibration device. It can be used for checking antenna systems and their associated transmission lines and receivers for catastrophic failures.

ORIGINAL**SG-354/U:1**

SAFETY PRECAUTIONS FOR RCA MODEL SSB-1 SINGLE SIDEBAND TRANSCEIVERS

Extreme caution should be exercised while making tuning adjustments on the transmitter or receiver of the RCA SSB-1 single-sideband transceiver which is presently undergoing evaluation by the Navy. The following specific precautions should be taken:

1. Both terminals of the plate-current metering jack are at 600 volts with respect to ground. Therefore, the transmitter should be de-energized when either making or breaking this connection.

2. The top of the neutralizing capacitor and the plates of the final amplifiers are at a potential of 600 volts with respect to ground and are in an exposed position when the top of the transmitter cabinet is opened. Extreme caution should be exercised to prevent bodily contact with these points while working in this area.

3. The final plate tank and the antenna-loading coil are at a high r-f potential with respect to the chassis of the equipment and ground. Extreme caution should be exercised to prevent bodily contact with these points while working in this area. The transmitter should be de-energized before attempting to move taps on either the final plate-tank coil or the antenna-loading coil.

RCA-SSB-1 SPEECH CLIPPER REMOVAL

The Bureau has received information that a number of ships have experienced improved performance of the Transmitter-Receiver RCA-SSB-1 when the Speech Clipper unit was removed.

Ships desiring to do so may make on-the-air checks with and without the unit. If the results of the test indicate use of the speech clipper is not desired, the unit may be removed. When the unit is removed, it is necessary to install a dummy plug. Instructions for this plug are contained on the equipment schematic diagram in the Technical Manual (NAVSHIPS 92917). The removed unit must be retained aboard and supplied with the equipment when removed from the ship.

RCA SSB-1 AND ELDICO S-100 PERFORMANCE AND OPERATIONAL REPORTS

Performance and Operational Reports for Single-Sideband Equipments RCA SSB-1 and Eldico S-100, may be discontinued except where failures occur in the equipment.

Specific information on the equipment failure detailed in the "General Remarks" space on this form is helpful in providing necessary equipment field changes.

TRANSCEIVER SSB-1 SAFETY PRECAUTIONS

The single-sideband transceiver SSB-1 is a commercial equipment provided for fleet use. Recent reports have

indicated that personnel have been receiving electrical shocks from various components of the equipment when retuning channels.

The original intent for use of this equipment was to initially preset four designated channels for operational use. The equipment was not intended for complete frequency changing with other crystals during the course of an operation. Reports have indicated that at times, radio men have been required to change frequencies on ten minutes notice. This increases the electrical shock hazard in addition to damaging components designed for normal commercial usage.

The Bureau of Ships have a field change under preparation for the elimination of all known danger points of this equipment. The field change will permit the replacement of metal tube caps with ceramic type caps, protection for the neutralizing capacitor, final tank components, and the ac power input connections.

The Bureau is also currently procuring an Antenna-Tuning Group AN/SRA-20 for use with the SSB-1. This antenna-tuning group is a four-preset-channel type.

All personnel are cautioned to use extreme care in the tuning of the SSB-1 equipment.

RADIO TRANSCEIVER SSB-1

Recent reports have indicated difficulties with the adjusting screws for the tunable inductance coils shearing off. These coils must be adjusted with each crystal-frequency change.

The USS SPINAX (SSR-489) has recommended that on-board repairs can be made by soldering a nut in place of the existing screw head.

The Bureau concurs with this recommendation and suggests that this repair be initiated on all SSB-1 equipments until improved methods can be established.

RCA SSB-1/AN/SRA-20 and Eldico S-100/AN/SRA-25; Removal from Ships

A number of ships and shipyards removing Radio Set SSB-1 have failed to concurrently remove the associated Antenna Tuning Group AN/SRA-20 (installed as Field Change 2-SSB-1). Stock activities have also reported that ships have turned in the SSB-1 and Control Unit C-2372/SRT but have not included the RF Tuner TN-329/SRT.

Failure to turn in the AN/SRA-20 or only portions thereof has resulted in equipment shortages, a stock control problem, and has reduced the quantity of equipment available for reissue.

All concerned are reminded that upon removal of the SSB-1 the associated antenna tuning units (AN/SRA-20) must also be removed as these units are a part of the prime equipment and were installed as an equipment field change.

A similar problem concerns the Eldico S-100 equipment and its associated antenna tuner AN/SRA-25 (Field Change 2-S-100).

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****T-347/SRT VHF SUBMARINE RESCUE BUOY; TEST CABLE HARNESS**

The Bureau has received reports that submarines and affiliated activities are not aware of the availability of the test-cable harness for the T-347/SRT VHF submarine distress buoy.

This test harness, described in the associated technical manual NAVSHIPS 91636, is available through the Electronic Supply Office. This test harness is stocked at the Supply Office of the Submarine Base, New London, Connecticut, under stock number NL5895-100-0001.

For additional information relating to test procedures of the T-347/SRT buoy reference should be made to EIB 478.

ORIGINAL**T-347/SRT:1**

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****RADIO RELAY LINK, UQ REPLACEMENT OF REAR BEARING IN BLOWER MOTOR B-201**

A beneficial suggestion has been submitted for replacement of the rear bearing in blower motor B-201 used in transmitter T-410/FRC.

At the present time, grease in the rear bearing becomes stiff, slowing the blower and causing failure of oscillator tubes. Replacing this bearing with one packed with high temperature grease eliminates failures due to stiffening of grease. The stock number of the replacement bearing is GM3110-144-8830.

ORIGINAL**T-410/FRC:1**

TAB-7 FAILURE OF TERMINATION TRANSFORMER

It has been brought to the attention of the Bureau that frequent failures of transmission-line-terminating transformer, T-801, part of field change 1-TAB-7, in the antenna-tuning unit, have been experienced at NRS(T) Kodiak, and NRS(T) Adak, Alaska. Up to this time, at least seven Transformers have failed for no apparent reason when operating the transmitter at or near full power output. This condition prevailed, even though the transmitter output and the antenna were carefully tuned.

Investigation disclosed that corona discharge was taking place around the body of transformer, T-801, and its connecting leads. This caused an eventual breakdown of the insulation between the primary and secondary windings and the core piece.

To correct the condition, transformer T-801 was insulated from ground by mounting it on four NT-60128 (Stock number

N-17-68771-9001) conical-procelain stand-off insulators. The transformer-terminal leads, connecting to the tap switch, were replaced with high-voltage insulated wire.

Since the modification, operating stability of the transmitter and antenna system improved, and no further failures have occurred.

It is recommended that all shore stations using the modified TAB-7 with a remote antenna-coupler installation, accomplish this change as soon as practicable. In view of the simple change required, a field change kit is not in order. However, the equipment history-record card should contain a notation of the modification referring to this article for the authorization.

The above modification was submitted as a beneficial suggestion to the Puget Sound Naval Shipyard by Mr. Frank Osborn, Electronics Technician, of the Assistant Industrial Manager's Seattle Office.

SHIPALTS REQUIRING REMOVAL OF TBL AND TAJ EQUIPMENTS FROM ACTIVE VESSELS DEFERRED

The problem of providing reliable communication during the entire twenty-four hour period out to a distance of 300 miles in certain vessels while operating in the auroral zone is under investigation and study by the Bureau of Ships. Pending completion of this study, it is desired to retain on board ship currently installed equipment operating in the 175-300 kc band but previously scheduled for removal in conformity with approved type installations. Accordingly, the Bureau of Ships by speedletter Ser. R-980-2178 dated 12 April has directed that:

"All outstanding shipalts requiring removal of TAJ and TBL equipments from active vessels in accordance with approved type installations are hereby deferred pending study and resolution certain communication requirements for vessels while operating in auroral zone".

CONTROL CIRCUITS FOR TAJ-11 THRU TAJ-18 TRANSMITTERS

The transmitter control circuit diagram (Fig. 1) which follows was prepared by the staff of the Radio Material School, Navy Research Laboratory. It is a simplified schematic diagram of the starting, stopping, and keying circuits for TAJ-11 through TAJ-18 transmitters.

TAJ SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Necessity for tedious tuning procedure for power-amplifier.

Whenever 3,000 volts was reached there would be an arc-over in the lower portion of the transmitter and the supply line fuse would be blown.

TAJ-11.-- The transmitter power-amplifier plate current meter read between 10 and 20 milliamperes, but this reading did not increase when tuned out of resonance. Antenna tuning had no effect.

TAJ-11.-- Motor-generator did not start when starting switch at transmitter was closed. Relay K-104. operated normally and the line contactor coil had proper operating voltage across it.

TAJ-14.-- Bias and plate signal lamps and meters showed no indication of operating voltages, but power signal lamp on the panel of the transmitter showed power.

It is not intended for this to be a complete schematic diagram of the entire equipment, but it is believed that it will be a help toward the understanding

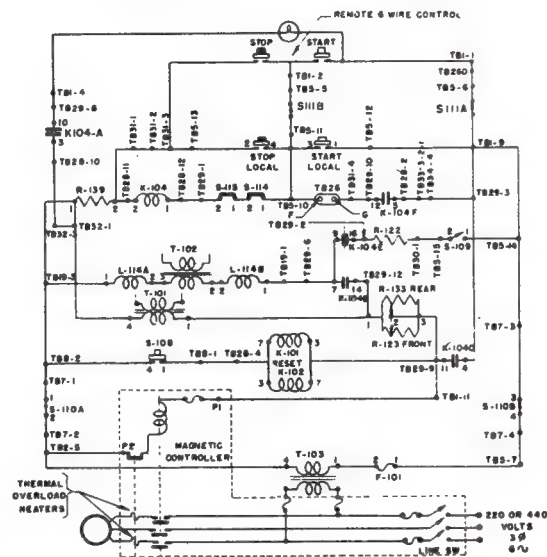


FIGURE 1.--Control circuits for models TAJ-11 through TAJ-18 transmitters, inclusive

Cause and Remedy

Due to excess interaction between antenna and power-amplifier circuits. Use the following procedure:

- (1) Adjust coupling control to a position of minimum coupling.
- (2) Tune power-amplifier to resonance with oscillator.
- (3) Tune antenna to resonance with power-amplifier.
- (4) Adjust coupling control for proper value of power-amplifier plate current.

It was found that the arcing was occurring between the high-voltage lead and the grounding strap for the lead shielding of this cable at the point of exit from the deck riser underneath the transmitter. Evidently the insulation had been nicked when cleaning the cable thus marking a weak spot which eventually led to this breakdown.

All operating voltages and other current readings normal. The screen series resistor R-105 was very hot. The power-amplifier screen was found to be grounded through capacitor C-122.

By disconnecting leads from line contactor coil N-113 and checking with an ohmmeter, the coil was found to be open. Normal operation was restored by installing new coil N-113.

Investigation showed that the transmitter motor-generator set would not operate. Further investigation showed the line contactor solenoid open. The solenoid was replaced and set operated normally.

COMMUNICATIONS**NAVSHIPS****900,000.1****SERVICE NOTES****Difficulty Encountered**

TAJ-11.-- Transmitter relay chattering.

TAJ-14.-- Transmitter would not key and keying relay was inoperative.

TAJ-15.-- Starting relay K-104 chattered badly when start button was pressed.

TAJ-10.-- Break down over insulation at capacitor C-151.

Cause and Remedy

Relay K-104 would not lock in when the power was turned on. Inspection disclosed that the contactor spring was caught on the link connecting the contact system to the armature and causing it to bind. The spring was returned to its normal operating position and the set functioned properly.

All voltages present and normal. All interlocks on band switches showed continuity. Discovered that contacts of overload relays K-103 had points that had worked loose and were not making contact when those relays were closed. After these points were readjusted operation of the transmitter returned to normal.

Found contacts dirty and out of alignment.

Investigation showed that cork insulator under connecting terminal was very thin, cracked and carbonized. Removed defective cork insulator and replaced with new insulator then returned capacitor to service.

TAQ SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Operating test key inoperative.

TAQ-9.--Quit keying. Would not key from either a local or remote position.

TAQ-9.--I-P-A meter M-102 was drawing current intermittently. Equipment would not key continuously and the transmitter would not stay in operation for long periods of time.

Cause and Remedy

Contact shorting bar of tube protective relay not making contact. Cleaned and dressed contacts.

Investigation showed that keying relay contact surfaces were dirty. After cleaning with contact burnishing tool and carbon tetrachloride, the set operated normally.

Set tuned up all right, initially, but operation erratic. Replaced i-p-a 803 tube and the set again operated normally.

POWER-AMPLIFIER GRID LEAK RESISTOR FOR TBA-10 EQUIPMENTS

Power-amplifier grid leak resistors (R-115) for use with TBA-10, contract NOs-64824, are now being distributed to NYMI and NYNYK and are available upon request to the yards indicated. Contact number and symbol number should be referenced in making requests direct to the Supply Officer for Radio.

MODIFICATION OF POWER SUPPLY PP-531/UR

Upon installation of subject equipment, no provision exists to incorporate the overload relays in the TBA-10 transmitter as a means of removing plate voltage in case of overloads. The fuses which are incorporated in the rectifier, however, provide adequate protection, but excessive fuse consumption while tuning the equipment is considered unfeasible.

To retain the original protective function of the transmitter overload relays, K-103, K-107 and K-108, the Bureau directs the following modification to be made to the equipments and technical manuals.

The portion of the control circuit of the TBA-10 transmitter, consisting of the series circuit through the normally

closed contacts of K-103, K-107 and K-108, is disconnected and brought out to unused terminals 7 and 8 of TB29. The original control circuit in the transmitter is then completed with a wire connection.

The connection from the coil of control relay K-705 which extends to the 115-volt supply is removed and run to unused terminal E702-9. A connection is then made between unused terminal E702-8 and terminal E702-5. Two (2) wires are then installed from rectifier terminals E702-8 and E702-9 to the transmitter terminals TB29-7 and TB29-8.

It is necessary to complete the circuit through the transmitter and land line control unit, which is normally connected through motor generator power transfer switch terminals 61-23 and 61-33 and the door interlock circuit, by connecting a lead between terminals 51-8 of the control unit and 29-3 of the transmitter.

The modification to the transmitter is for the TBA-10. Other series of the TBA require the same modification, but the leads are brought out to unused terminals other than TB29-7 and TB29-8. The door interlock circuit through the motor-generator transfer switch on these transmitters is connected to terminal 51-8 of the land line control unit.

Any changes made to the equipments should be noted in the equipment technical manuals.

TBA SERIES TROUBLE SHOOTING NOTES**Difficulty Encountered**

TBA-6.--No plate voltage in first i-p-a stage.

TBA-6.--Low plate voltage on all i-p-a stages, and upon keying the set, meter M-101 would read zero.

TBA-6.--Very low indication on power-amplifier grid meter and no output available from power-amplifier of the transmitter.

Cause and Remedy

Broken solder connection on L-126.

High voltage fuse A4 at the motor-generator blown.

The power-amplifier grid leak resistor R-115 failed.

Another resistor of the correct resistance and higher power rating was installed, and the operation of the equipment was returned to normal.

INSTALLATION INSTRUCTIONS FOR RECTOX UNITS

Rectox units FSN N6130-696-8306, part No. 58-B-7668, used in rectifier units for Transmitters TBK and TBM, Symbol CR-916, were procured as replacements for FSN N6130-250-2189, part No. 1312218.

Some activities have been unable to make the proper hook-up of the replacement units because of difficulty in determining the correct terminals to use. The following instructions published by the manufacturer are printed here for information:

1. Connect (+) terminal of rectifier to No. 8 on terminal board.
2. Connect (-) terminal of rectifier to AC on terminal board.
3. Do not use AC terminal on the selenium rectifier.
- *4. Connect CR-916 No. 8 to CR-918 No. 8.
- *5. Connect CR-917 No. 4 to CR-919 No. 4.
- *6. For 1000V DC output required on TBK-16, connect T-904 No. 8 to AC on terminal board.

VACUUM TUBE KEYING ON TBK TRANSMITTING EQUIPMENT

All shipborne TBK series transmitting equipments subsequent to TBK-8 and manufactured by Westinghouse Electric Corporation may be readily modified to provide high-speed vacuum tube keying anywhere up to and including 500 words per minute. The material, modifications, wiring, installations, etc., necessary to realize high-speed vacuum tube keying in the equipments operated from an a-c power source are shown on Figures 1 to 10 inclusive.

The vacuum tube keyer unit, built in accordance with drawing on Figures 1, 2 and 3 and including a type 807 vacuum tube, should be mounted directly behind and below the master oscillator tube access door. Refer to installation drawing on Figures 4 and 5. The keyer terminal strip, shown in detail on Figures 6 and 7, should be mounted, as shown on drawing, Figures 4 and 5, on the lower side of the panel immediately below the master oscillator chassis. (This terminal strip does not necessarily have to be in strict accordance with drawing on Figure 6 so long as the terminal strip employed performs the same functions.) A hole should be cut, as shown in detail on Figure 5, in the panel supporting the keyer terminal strip for the flexible leads connected between the keyer unit and the keyer terminal strip and also for the leads connected to the "Vacuum Keying-Relay Keying" switch. A felt collar should be provided around the edges of the hole to protect the leads from unnecessary wear. (The size and shape of this hole are only approximate--individual judgment should be exercised.) If desired and thought more practical, individual holes may be drilled in the panel and provided with rubber grommets for each lead instead of cutting a hole as called for above. Mount a double pole-single throw toggle switch (AWS no. ST50K), as shown on Figure 4, on the front panel of the transmitter immediately below the doubler circuit tuning control "C". In connection with this, be certain that a nameplate, in accordance with drawing on Figure 8, is mounted on the front panel of the transmitter over the toggle switch. (The location of the toggle switch and its nameplate may be varied somewhat from that shown on the drawing.) Mount three resistors, R-52 (5,000 ohms--Navy type 63085E), R-53, (25,000 ohms--Navy type 6309E), R-54 (5 ohms--Navy type 63046E) as shown on Figure 5, on the two resistor

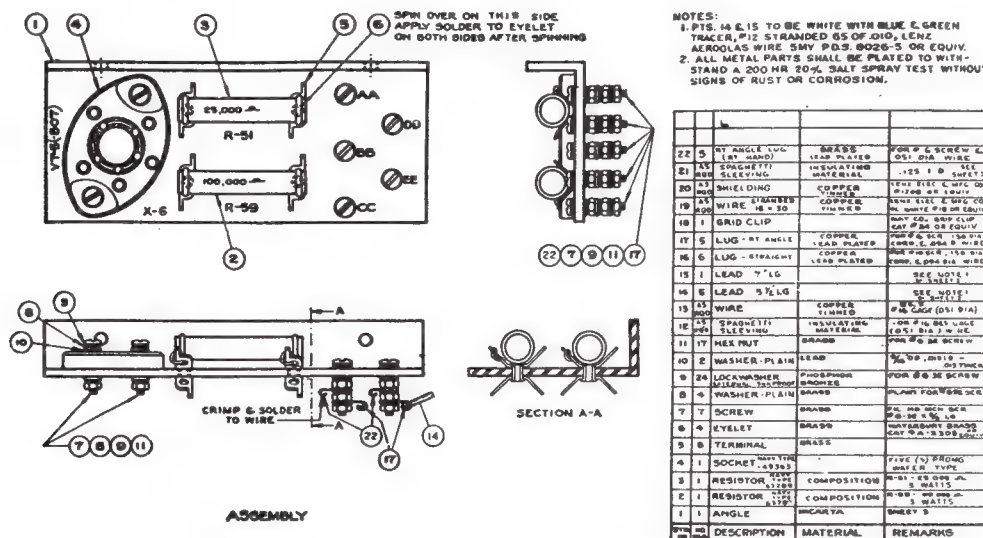


FIGURE 1.--Vacuum tube keyer unit.

*Refer Figure 14-31 (Schematic Diagram Rectifier Power Unit Type CAY-20228) in TBK-16 Technical Manual.

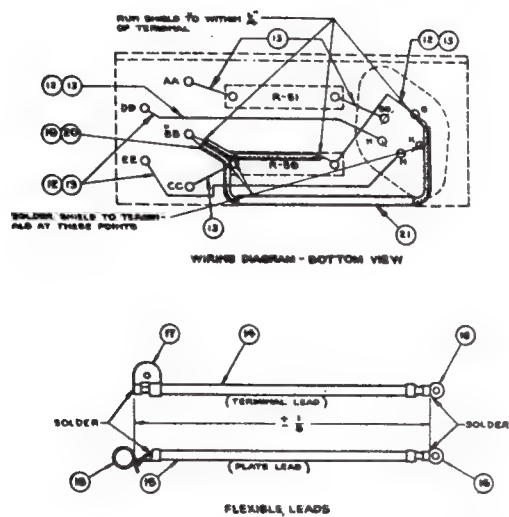


FIGURE 2. --Vacuum tube keyer unit wiring diagram (bottom view) and flexible lead details

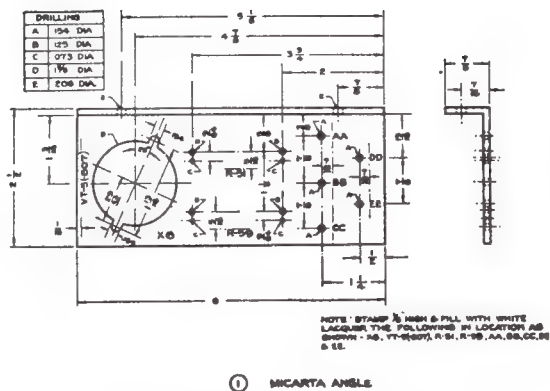


FIGURE 3.--Vacuum tube keyer unit details

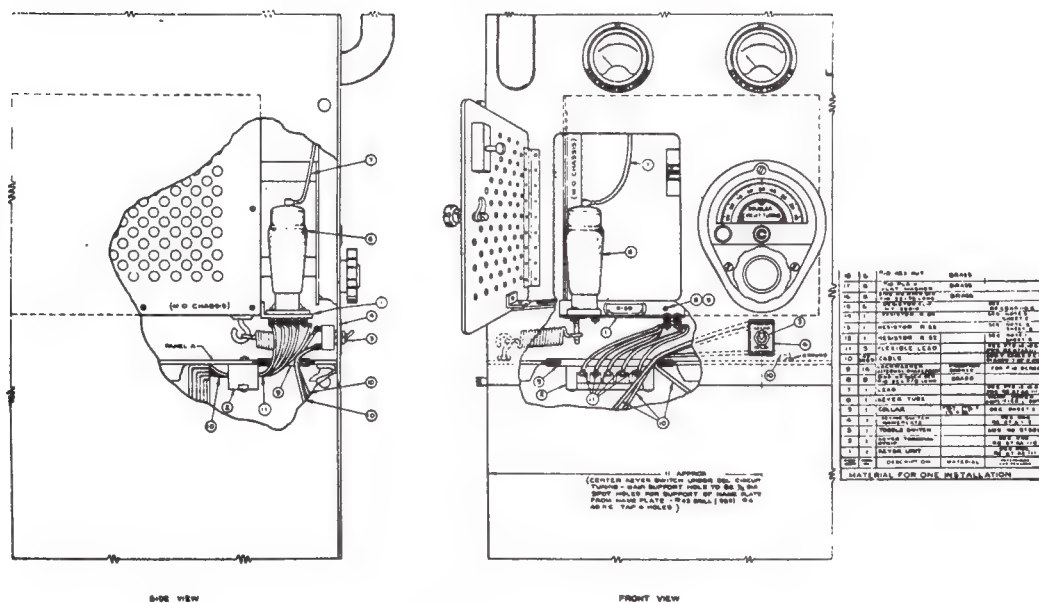


FIGURE 4.--Cutaway illustration of the master oscillator unit

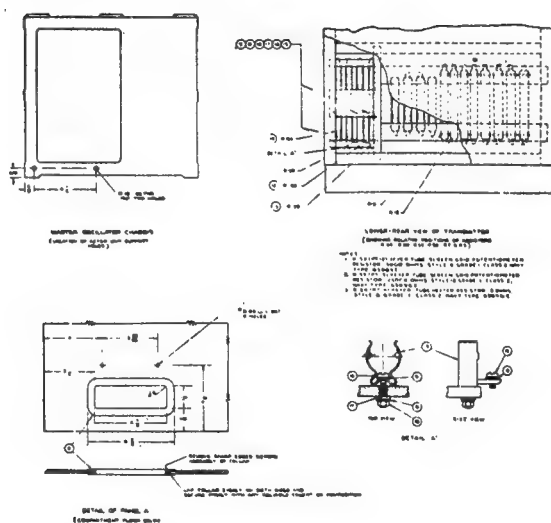


FIGURE 5. --Installation drawing for keyer unit

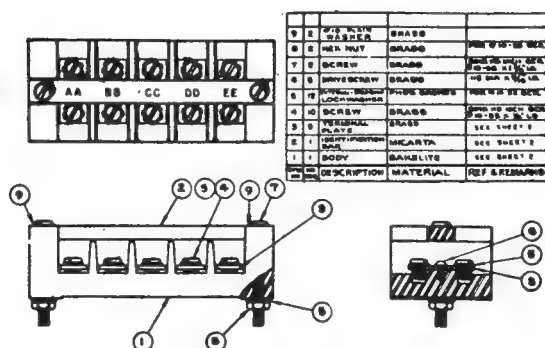


FIGURE 6. --Keyer terminal strip

mounting strips located in the rear lower left hand side of the transmitter. (In some transmitters, resistor clips and terminals and dummy resistors are provided while in other transmitters only mounting holes are provided in the resistor mounting strips.) After the keyer unit and its associated components have been installed as explained above, the necessary wiring should be carried out as shown on the wiring diagram Figure 9, on the schematic diagram Figure 10, and on the installation drawing Figure 4. (Be sure that all notes on the referenced drawings are adhered to.)

The plate of the keyer tube is effectively connected in parallel with the screen grid of the master oscillator tube (Connect the flexible plate lead of the keyer tube to the positive terminal of the master oscillator screen current meter M-8). The screen grid of the keyer tube is connected through dropping resistor R-51 to the keyer tube screen grid potentiometer consisting of resistors R-52 and R-53, which is connected across the 1000-volt master oscillator plate and screen grid supply. The control grid of the keyer

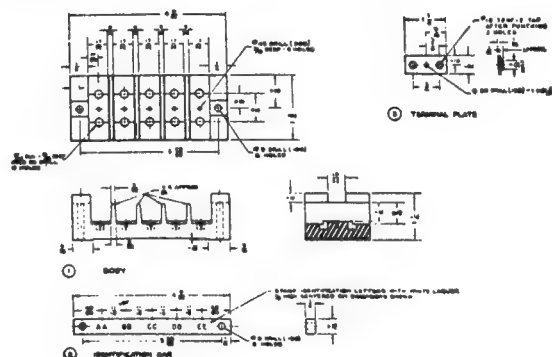


FIGURE 7. --Terminal strip details

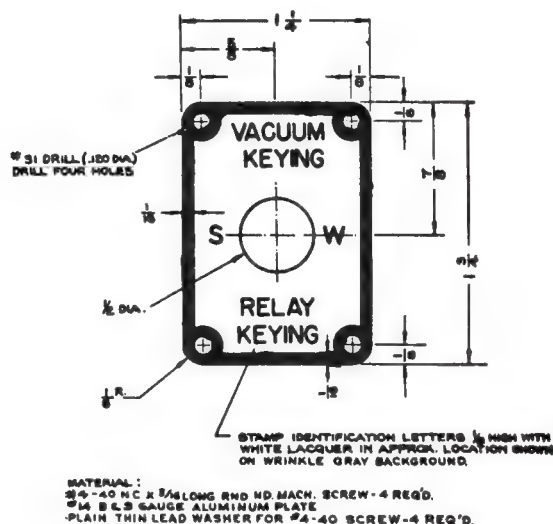


FIGURE 8. --Keyer switch nameplate

tube is connected through resistor R-59 to the cathode of the keyer tube, which is grounded. The control grid of the keyer tube is also connected to terminal 47 on the transmitter terminal board. One side of the keyer tube heater circuit is connected to terminal 45 on the transmitter terminal board while the other side is connected through dropping resistor R-54 to terminal 12 of the transmitter filament transformer T-1. Terminal 10 of transformer T-1 is connected to terminal 44 on the transmitter terminal board. (Before the heater circuit is connected to terminals 44 and 45 on the transmitter terminal board, make sure that there are no connections between terminal 44 and terminal 8 of the transmitter step-down transformer T-5 or between terminal 45 and terminal 6 of the transmitter filament transformer T-1). From terminals 44 and 45, the heater circuit is then connected in series with one pole of the "Vacuum Keying-Relay Keying" switch "SW" so that the keyer tube heater circuit can only be excited when switch "SW" is placed in the "Vacuum Keying" position ("ON" position

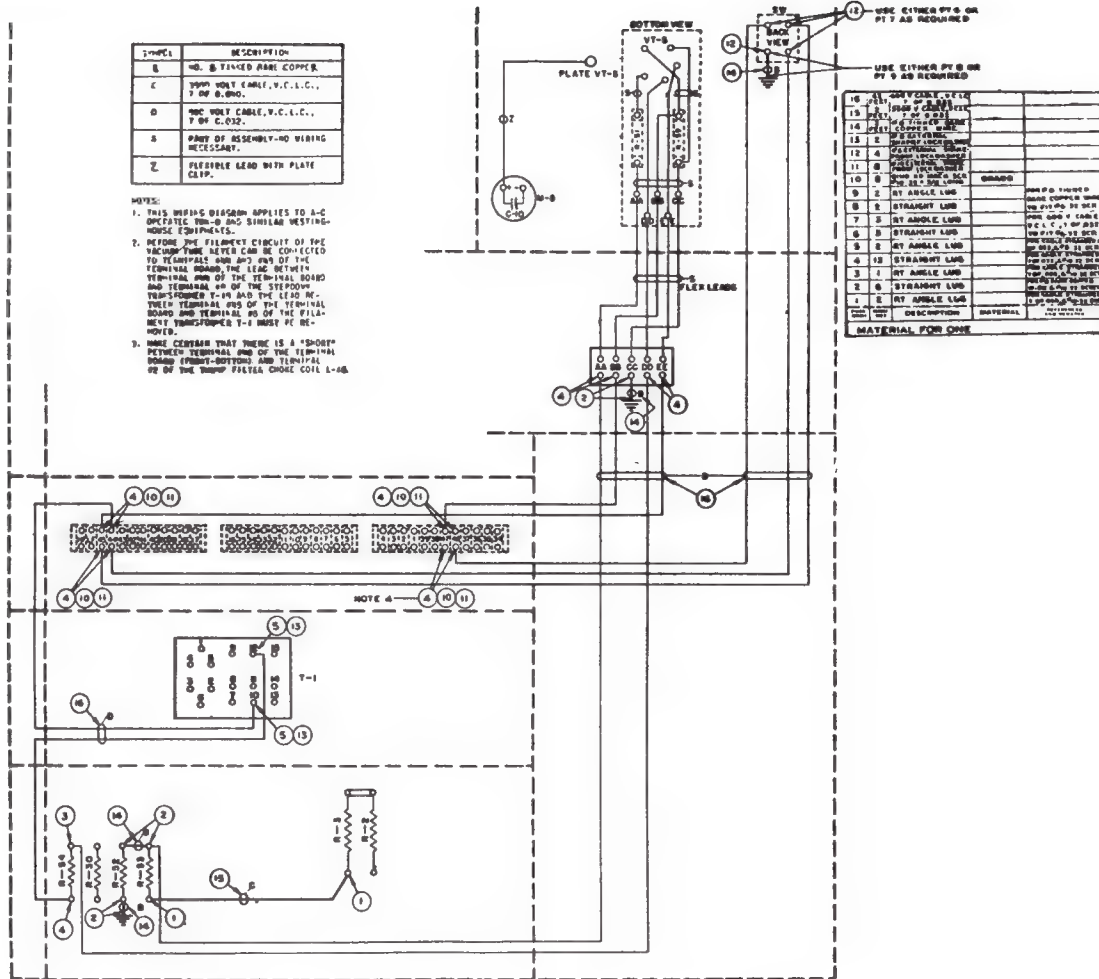


FIGURE 9. --Vacuum tube keyer wiring diagram

of the double pole--single throw toggle switch). Next, terminal 46 of the transmitter terminal board is connected to the other pole of switch "SW" and the pole grounded so that when switch "SW" is placed in the "Vacuum Keying" position, the transmitter thump filter choke coil L-16 is shorted to ground (Make certain that there is a "short" between terminal 46 and terminal 2 of the transmitter thump filter choke coil L-16).

When the keyer tube heater circuit is excited (First the keyer switch "SW" should be thrown in the "Vacuum Keying" position and then the "Test Key" S-10 of the transmitter should be thrown in the "lock" position. It should be noted that when vacuum tube keying is employed, the "Keying Relay" K-1 and the "Compensating Relay" K-2 must be locked in (continuously energized) by either throwing the "Test Key" S-10 in the "lock" position or by some other convenient outside means), the plate of the keyer tube draws current through the master oscillator screen dropping resistor R-2; this reduces the master oscillator screen grid voltage to a low value and the master oscillator

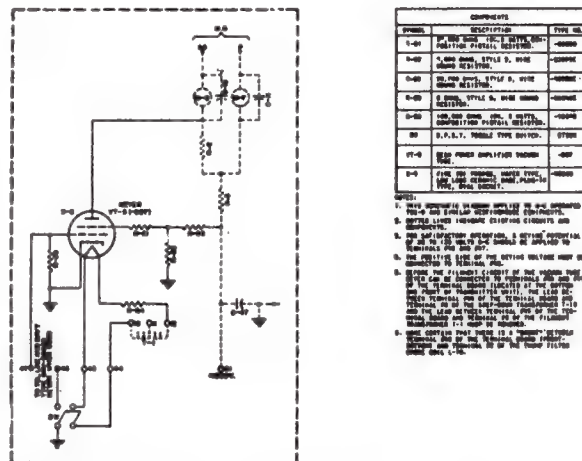


FIGURE 10. Vacuum tube keyer schematic diagram.

will not oscillate. When a voltage of the correct polarity is impressed on terminals 46 and 47 of the transmitter terminal board (a d.-c. potential of from 35 to 125 volts should be provided—the positive side of the keying voltage must be connected to terminal 46. The keying voltage may be applied and controlled by either a standard hand key or by a standard Navy keyer, such as the Navy type CRV-50059 keyer), the keyer tube is biased to plate current cut-off; the master oscillator screen grid voltage rises and the master oscillator will oscillate normally. (It should be noted that when the keyer tube heater circuit is not excited, the vacuum tube keyer circuits do not in any way affect the operation of the transmitter circuits).

TBK CATHODE MODULATOR

The NYMI constructed a number of cathode modulator units to provide A₃ emission with the TBK series transmitters. Inasmuch as a number of ships have these equip-

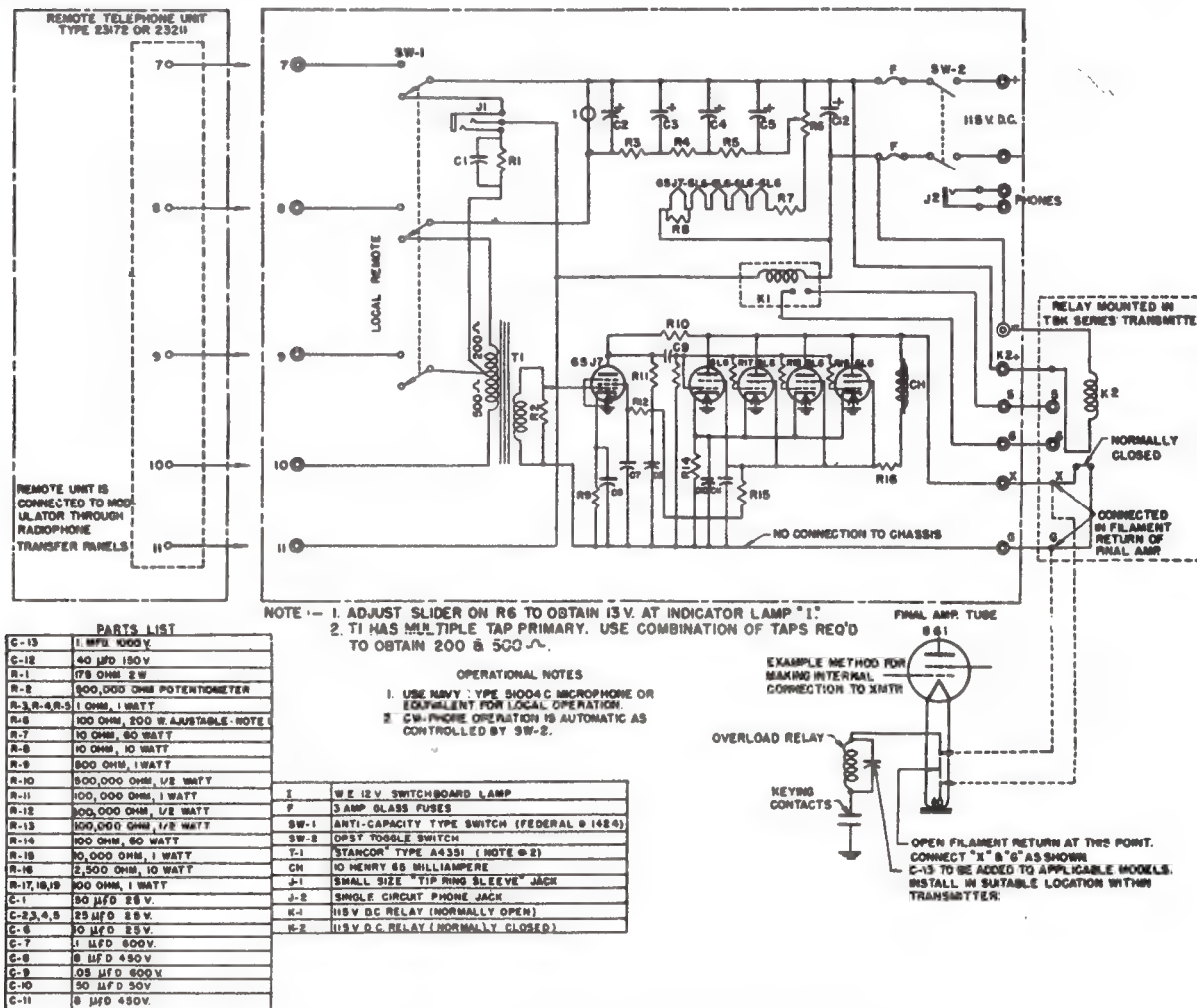
ments and maintenance data is not available to these vessels, the following diagrams are supplied for assistance in the maintenance of this equipment. Figure 1 shows the schematic and figure 2 shows the type plan wiring diagram.

Only a limited number of these modulators were built and the publication of this maintenance data should not be construed as Bureau authorization for installation of these modulators on ships not already having them.

OVERHEATING IN MASTER OSCILLATOR OVEN COMPARTMENTS ON TBK TRANSMITTERS

The following information regarding the TBK Transmitting equipments was submitted by the Service Force, U. S. Atlantic Fleet, and is reprinted as being beneficial to all maintenance personnel:

(a) In the last three TBK transmitters, it has been found that the master oscillator oven compartment was overheating as indicated by the mercury column being out



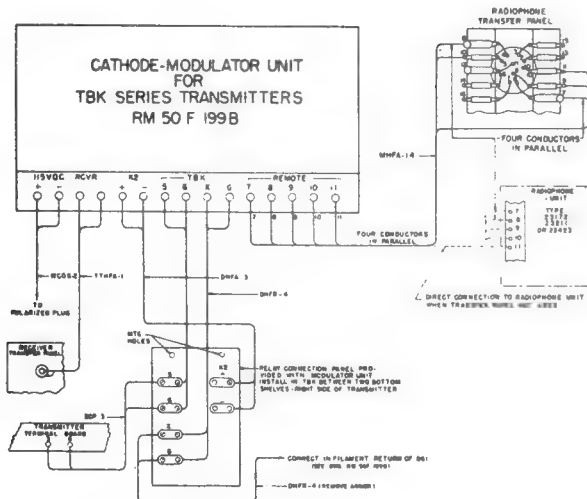


FIGURE 2. Type plan wiring diagram of the cathode modulator for the TBK.

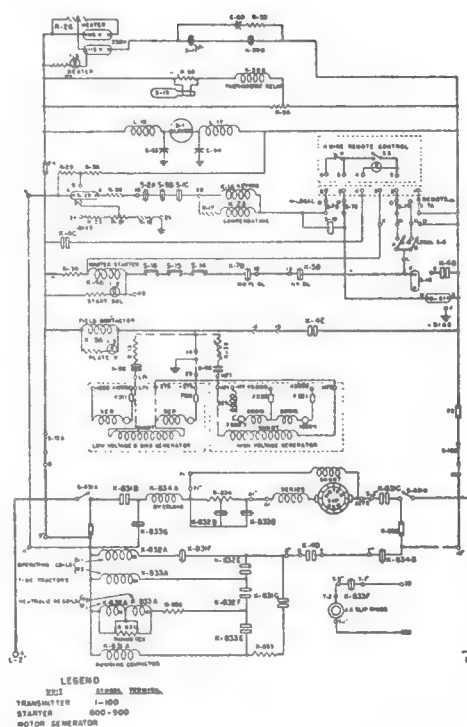


FIGURE 2. Control circuits for model TBK-13 transmitters.

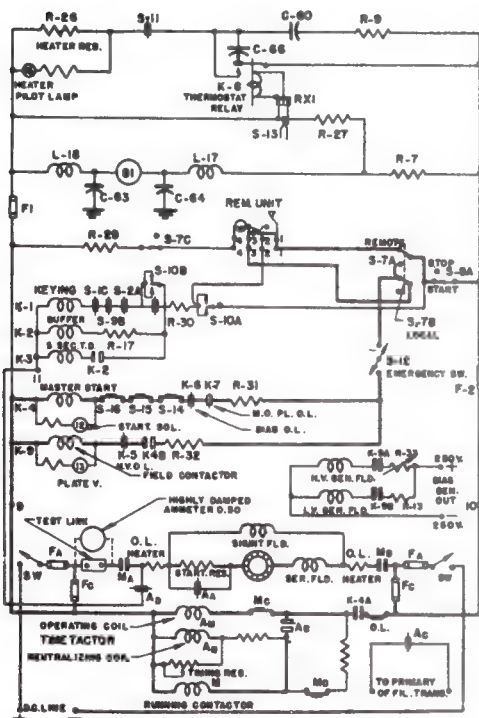


FIGURE 1. Control circuits for models TBK-5 and TBK-6 transmitters.

of sight at the top of thermometer on the front of the compartment. This overheating resulted, not only in drifting of the master oscillator frequency, but in damage to components and changing of capacitor values.

(b) The oven compartment operates as follows: When the transmitter is initially turned on, with the temperature below 50° C., the mercury thermostat (S101) and the Cartridge type thermostats (S102) and (S103) are all closed. The heater relay (K108 in a.c. equipments and K118 in d.c. equipments) is also closed and the amber indicating light (I104) is lit. When the temperature rises to 50° C., S102 opens, opening the auxiliary heating circuit. After the temperature reaches 60° C., S101 opens, opening the main heating circuit which extinguishes the amber indicating light (I104). In case either one or the other of the aforementioned switches fail to open, S103 opens both heating circuits at 70° C.

(c) In case No. 1, the complaint was that the master oscillator drifted when the transmitter was keyed, causing difficulty when used with the frequency shift keyer. When the transmitter was turned on, the mercury column in the thermometer rose rapidly. At 60° C. the amber indicating light went out, but the temperature continued rising until the mercury column was out of sight at the top of the thermometer. A voltmeter across S102 disclosed that it was not opening at 50° C. S102 was replaced and the oven compartment heated normally. (A voltmeter across any one of the three switches will indicate a voltage drop when the

switch is open, but there will be no voltage drop when the switch is closed.)

(d) In case No. 2, the master oscillator would not tune on band 6. When the transmitter was turned on, the mercury column rose rapidly to the top of the thermometer and the amber indicating light remained on. The contacts of the heater relay were found to be stuck thus keeping the main heating circuit energized. Straightening of the contact arm corrected this trouble. This serious overheating of the compartment had damaged C107 and C108 in the grid circuit of the master oscillator so that oscillations could not be sustained on band 6, the highest frequency band of the master oscillator. Replacement of these capacitors resulted in normal operation on band 6.

(e) In case No. 3, the transmitter tuned up on dial settings which varied widely from the recorded settings. When the transmitter was turned on, the mercury column rose rapidly to the top of the thermometer and the amber indicating lamp flickered on and off. S101, the mercury thermostat, was found to be not opening at 60° C., therefore, S103 was opening both heating circuits at 70° C., actuating the amber indicating light. S101 was replaced and the compartment then heated normally. This oven compartment overheating had resulted in changes in values of two capacitors in the frequency determining circuit in the grid circuit of the master oscillator. Replacement of these capacitors brought the dial readings back in accordance with the original recorded readings.

CONTROL CIRCUITS FOR TBK-5, TBK-6 AND TBK-13 TRANSMITTERS

The transmitter control circuit diagrams which follow were prepared by the staff of the Radio Material School, Naval Research Laboratory. They are simplified schematic diagrams of the starting, stopping, and keying circuits for the TBK-5 and TBK-6 and TBK-13 transmitters.

It is not intended for them to be complete schematic diagrams of the entire equipment, but it is believed that they will be a help toward the understanding and servicing of the control circuits of these transmitters.

Figure 1 shows the control circuits for the TBK-5 and TBK-6. Figure 2 shows them for the TBK-13.

CONVERSION OF TBK AND TBM SERIES EQUIPMENTS TO A TWO-WIRE OUTPUT

The TBK/TBM type of transmitters may be converted to two-wire line output by removing the ground from C-42 and attaching the feedlines to the normal antenna post and the rotor of C-42. The late models of these transmitters have C-42 mounted by three machine screws and metal sleeves. By replacing these sleeves with small standoff insulators, the ground is effectively removed. No other change or additional equipment is required. Tuning is accomplished in the normal manner. It will be noticed that the power-

amplifier will load with decidedly less capacity in C-41, thus reducing harmonic and spurious radiation due to close coupling. There will be less interaction between the tuning of the antenna system and the power-amplifier, which will speed up the process of tuning to a new frequency. The line will be resonant and have the usual efficiency of resonant lines. The system may be used to feed any type of antenna throughout the frequency range. A center-fed half-wave antenna cut for 4 mc. with a spaced 600-ohm transmission line of any length adapts itself satisfactorily to any frequency. When using this type of antenna on its harmonics, care should be used in proper orientation as the directivity is marked.

MARKING OF MOTOR-GENERATOR SETS SHIPPED WITH TBK-13 AND TBM-7 EQUIPMENTS

Due to a diversion of equipments, it became necessary to ship TBK-15 and TBM-8 motor-generator sets with TBK-13 and TBM-7 transmitting equipments. This procedure resulted in motor-generators with armature shafts marked "TBK-13" or "TBM-7" being shipped with TBK-15 and TBM-8 equipments. Since the armatures of all of these equipments are entirely interchangeable, no harm results except that confusion might occur during the removal or replacement of the armature units.

Installation and maintenance activities should make specific note of the above fact in order that no confusion or delay will result when the irregularity is encountered.

LUBRICATION OF BLOWER MOTORS IN TBK-17

It has been pointed out to the Bureau that the blower motor (B-104A) for the TBK-17 transmitter was received from the factory without grease in the bearings and as a result the unit was damaged after about 25 hours' service.

All maintenance activities are urged to check blower motors in all transmitters when received from the factory for proper lubrication and if insufficiently lubricated the bearing should be packed with Navy specification 14-L-3, Grade II ball bearing lubricant.

TUNING PROCEDURE IN TBK-17 (TBK-8, -10, -12, -14) WHEN USING WESTINGHOUSE 861 TUBES

Due to slightly different characteristics between RCA and Westinghouse 861 type tubes, the instructions for tuning the transmitter for frequencies up to 16 mc. are correctly given in paragraphs 4.41 to 4.67 in the instruction book for both types of tubes and this applies also to the RCA 861 above 16 mc. When using the Westinghouse 861 above 16 mc. use the instructions given in paragraph 4.68 to 4.70 in the technical manual.

TBK SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Transmitter failed to key.

Output failed completely.

TBK-12.--Transmitter could not be made to double.

TBK-12.--Master-oscillator oven failed to come up to proper temperature.

Would not key or erratic keying.

No bias voltage on transmitter as indicated by meter.

Plate voltage very low as indicated by plate voltmeter.
Continuous heavy arcing across contact "B" of relay K-105.

Bad knock in low-voltage generator.

TBK-13.--No plate voltage except in oscillator stage.

TBK-14.--No high voltage output.

TBK-12.--Could get no excitation into p-a stage.
Monitoring receiver note "mushy" and unstable.

TBK-10.--Transmitter would not load and first i-p-a tuning very critical.

TBK-12.--Improper reading of meters as follows:
Master-oscillator screen and plate current meters normal. First amplifier plate current meter 10 ma. Second amplifier plate current meter 4 ma. Power-amplifier plate and grid meters zero.

TBK-14.--Continual blowing of fuses in heater circuit of transmitter.

TBK-14.--Noise interference in receivers when high voltage applied to TBK.

TBK-15.--Poor CW note and frequency "wobble."

TBK-17.--No power available at generator. Main fuse kept blowing.

TBK-18.--No output from transmitter; no screen voltage on the 861 tube.

Cause and Remedy

Trouble was located in the interlock of the frequency range switch. Spring tension was too light. This was remedied by bending the spring to the proper tension. Corrected by cleaning all connections in transmitter and antenna trunks.

Defective 860 tube (first intermediate amplifier). Replaced. A check of the oven heater circuit showed that the leads to S-101 and S-103 were reversed. This allowed S-102 to open the circuit to the heaters when the temperature reached 50° C. The leads were connected in the proper way and operation was normal.

The shaft holding one side of the switch interlock (S-107) had broken and the interlock would not close. A new shaft was made in the machine shop.

The brushes on the bias generator were not making good contact.

Found capacitor C-153 shorted. Replaced--normal operation restored.

Found to be caused by loose flange in generator shaft coupling. Corrected by properly securing flange to shaft.

Wiping contacts on switch S-9A not making contact properly. Normal operation restored by cleaning and adjusting contacts.

Bias voltage relay K-105 would not close. Adjusted spring tension and the set operated normally.

Cleaned sliding contacts on variable inductances and tightened springs on contact roller arms. Also tightened connection at r-f chokes. Operation then normal with good signal report.

Due to dirt on first i-p-a coil. Cleaned thoroughly and operation satisfactory. Also cleaned antenna coil and contacts on antenna transfer switch.

Found to be due to burned out R-134 which caused floating screen grid in first and second I-P-A.

Trouble was traced to soldering lug on the lead from the thermometer switch, secured under a binding post on the bakelite mounting strap. This lead shorted to the metal of the oven. The lead was secured so that it would not ground and no further trouble resulted.

Found C-152 defective. Replaced.

Caused by loose screw in master oscillator range switch S-1. To tighten properly, the entire MO unit must be removed.

Found one of the leads on the line transformer T-103 shorted. Repaired same and unit functioned normally.

Found the screen by-pass capacitor C-37, type 48037-10, shorted. Replace from spares. Normal operation restored.

TBK SERIES TROUBLE SHOOTING NOTES--Continued**Difficulty Encountered**

TBK 11.--M.O. drawing continuous plate current when on remote position but not on local.

TBK-12.--Motor-generator created interference such that reception on the RAO receivers was impossible. Int. peaked at around 8500 kc.

Cause and Remedy

Arc suppressor capacitor C-503 shorted to ground, causing keying relay K-14 to be continually energized, thereby closing the keying circuit. Trouble required replacement of the faulty capacitor.

Cleaned and reseated the brushes on the motor-generator. A check revealed no interference detectable from this source with receivers operating at full gain.

MODEL TBL RADIO TRANSMITTER CAUTION REGARDING STAR WASHERS

Several model TBL transmitters in which the mica-lex end plates of H.F. antenna inductance L-25 had been so badly burned due to corona discharge that replacement of the end plates was necessary. The cause was traced to the use of sharp pointed star washers used in the assembly of the inductance. Very noticeable burn marks were observed near each point of the star washers. Some TBL inductances have been observed to have been assembled utilizing flat washers. No difficulty due to corona discharge has been apparent in this case.

It is recommended that all repairs and reassemblies of TBL HF antenna inductances be made using flat washers anchored with glyptol. Inspections of all transmitter finals should include action to eliminate any sharp points that are in close proximity to final amplifiers.

WARNING OF HIGH D-C POTENTIAL ON ANTENNA CIRCUITS OF TBL RADIO TRANSMITTING EQUIPMENTS

A report has been received by the Bureau stating that personnel were injured by a high d-c potential existing on the antenna circuit of a TBL-12 transmitter. The person injured did not come in direct contact with the circuit itself. An electrical arc of over 3 inches was created between the circuit and the person's hand, resulting in shock and severe burns. The high d-c potential was due to contact between (1) the high-voltage bus (between the i-f P.A. range switch, S-20, and the i-f P.A. tank variometer, L-22) and (2) the lead from the i-f P.A. antenna tuning variometer

L-27, to the i-f antenna blocking-capacitors, C-91 and C-95. It is possible that the high-voltage bus had been riding on the edge of the insulated side of capacitor C-95, and that vibration caused the bus to shift position and come in contact with the lead to the variometer L-27. Care should be exercised by installing activities and all vessels should periodically check their equipments to insure that all such leads and busses are supported properly in order to prevent casualties and safeguard personnel.

SHORTENING OF SHAFTS ON THE TBL MOTOR GENERATOR

Norfolk Naval Shipyard has submitted a recommendation to BuShips that the ends of the shafts on the TBL motor generator be shortened sufficiently to allow replacement of coupling discs without removal of individual units from the base.

There is only 13/65 inch clearance between shaft ends of the individual units, and the coupling disc is 3/8 inch thick, making it necessary to remove one or more of the units from the base to make the necessary repairs. This upsets the alignment and balance which is difficult to restore and impractical to accomplish by ships personnel.

It has been found that by shortening the shaft ends, approximately 3/8 inch, bringing them flush with the couplings flanges, insertion of a new coupling disc may be made without disassembly of the unit. Reports then may be made by ships personnel, eliminating the necessity of a yard overhaul.

The Bureau has no objection to the shortening of the shafts as indicated when found necessary by activities making repairs to Model TBL motor generator.

TBL SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Transmitter fails to start from bridge remote control unit.

Transmitter not tuning properly.

Plate voltage meter M-10 shows voltage when S-22 is in step 1 position.

High-frequency m-o screen current meter M-1 shows current flow with key up.

Motor solenoid indicator light I-9 burns when pressing "start" button but transmitter does not start.

Bias voltage indicator lamp I-4 burns too brightly.

Transmitter will not shut down when "stop" button is pressed.

Erratic tuning of master-oscillator.

Cause and Remedy

Corrected by repairing broken lead on terminal board in remote control unit.

Corroded contacts on p-a band switch. Cleaned all switch and relay contacts.

Condenser C-26 shorted.

Condenser C-12 leaky or shorted.

K-13 series resistance (175 ohms) open.

Lamp connected to incorrect resistor tap at factory.

Starting contactor relay stuck in closed position due to relay armature being held by sticky tar on magnet pole face.

Remove side from oscillator compartment. Tighten set screws of metal collars holding fiber shaft secure to metal shaft. This operation suggested as a routine check because in time these shafts become loose as a result of heating.

TBL SERIES TROUBLE SHOOTING NOTES--Continued

Difficulty Encountered

Erratic tuning of high-frequency intermediate-amplifier stages.

TBL-6.--Overheating of tube plates in final amplifier stage due to loss of bias.

Voice modulator equipment smoked when power applied.

Blower motor developed excessive noise.

TBL.--Would not start.

Moisture condensation in submarine antenna trunks.

TBL-7.--Drop in bias generator output to 110 volts; drop in m-o plate voltage to 700 volts. Insufficient voltage to operate either master-oscillator when keyed.

TBL-7.--Transmitter inoperative from type COT-23211-A remote radiophone units. Model TDE-1 transmitter operated normally from same unit.

TBL-7.--Transmitter tuned up correctly but developed a large arc across the TUNE-OPERATE switch when thrown to full power.

TBL-7.--High-voltage relay would not throw out when door interlock was opened.

TBL-7.--Transmitter would not shut down. The motor-generator ran continuously whether interlocks

TBL-6.--No signal from the high-frequency master-oscillator tube. No indication on meter for first doubler tuning stage.

Cause and Remedy

This trouble caused by poor contacts between wheel and cross bar and between moving contacts on end of coils.

Suggested remedy--clean parts...

Note: Use nonconducting abrasives such as sandpaper, crocus cloth, ink erasers, etc. **Do not use** conducting abrasives such as emery paper or cloth.

During times of vibration or gunfire it was noticed the final amplifier tube plates were drawing excessive current as evidenced by plates showing a bright red color. This trouble was traced to the filter unit and, removing leads and bolts from the terminal strip, it was found that the heavily tinned solid conductors, especially those connected to terminals 59, 60, 61 and 62 were improperly soldered and could be turned within the lugs with only slight pressure. A proper solder job corrected the equipment.

Difficulty traced to bias network in filament circuit of the type 2A3 power output tubes. Replaced 10-mfd. 100-volt condenser and normal operation restored.

Found high resistance armature winding in motor.

The trouble was traced to the keying position where wiring had forced the shorting bar on the stop side of the switch closed.

Submarine antenna trunks may be dried by placing a 200-watt incandescent lamp in lower end.

Traced to loose bolted connection to generator field resistor R-150.

Found wire disconnected from speech input transformer in CME-50064 speech input equipment due to poor soldering job. Normal operation restored by properly soldering wire to lug.

Checked plate circuit for grounds--all OK. Found that trouble disappeared when antenna current meter was disconnected. Checked blocking capacitors between p-a plate and antenna--all OK. Found small scrap of metal from yard "chipper" or welder lodged between the antenna and plate coils. Normal operation restored when scrap was removed.

Cleaned and adjusted high-voltage relay.

Found starting contactor relay K-13 contacts welded shut.

After the contacts had been filed down, the transmitter control worked properly.

Discovered finger of high-frequency master-oscillator range switch S-1A to be making contact on two pins instead of one pin. The adjusting screw on the collar of the switch rod was loosened, the finger was set on the proper tap, and the set screw was then tightened. The transmitter functioned normally after these corrections were made.

TBL SERIES TROUBLE SHOOTING NOTES--Continued**Difficulty Encountered**

TBL-5.--Frequency continually changing.

TBL-7.--No plate voltage and no bias voltage.

TBL-8.--Loud interference in audio phone jack and absence of signal from frequency meter made oscillator tuning impossible.

TBL-12.--No. i-f oscillator filament voltage; h-f oscillator and 1st amplifier filaments burn continuously.

TBL-6.--High oscillator plate current.

TBL-7. --Transmitter would not tune up beyond the first amplifier stage with range switch in the high position.

TBL-7.--Transmitter keyed intermittently with the roll of the ship, although keying relay was not closing.

TBL-7.--Excessive wearing of brushes in blower motor.

TBL-7.--No meter readings on amplifiers.

TBL-7.--Master-oscillator tuning erratically.

TBL-8.--Transmitter power amplifier plate current erratic with frequent blowing of high voltage fuse and frequent operation of overload relay. Plate current was not greater than 300 ma.

TBL-13.--Motor-generator would not start.

TBL.--Unable to tune 1st. IPA on the high-frequency side of the transmitter.

TBL-7.--Intermittent operation of transmitter after being turned on.

TBL.--No d.-c. voltage output when generator is rotating in proper direction. Low d.-c. voltage output when generator is rotating in reverse direction. Shunt field connected in series on low d.-c. self-excited generator. Excessive arcing at 1,000-volt d.-c. commutator.

Cause and Remedy

The plunger that goes back and forth on the worm and passes through the coil to tune the high-frequency master-oscillator tank coil, circuit symbol L-1, was loose on the worm. Shock or sudden movement or jarring action would cause the plunger to move and thereby change the frequency. This frequency drift is different than the frequency drift resulting from lack of proper oven heat. Increased spring tension between plunger and worm was effected and operation was satisfactory thereafter.

Transmitter thoroughly checked and found normal. Motor-generator checked and found normal. Trouble found to be in the model CRV 29017 attenuator unit which is used in conjunction with the RAK-RAL receivers. This unit had the 115-volt d-c line reversed. Changed to proper polarity. Operation normal.

Found brush on 1600-volt generator badly pitted causing variation in oscillator plate voltage. Trouble eliminated by properly fitting brush with sandpaper.

Nut and lock washer came off the bolt fastening the arm which throws S-6, S-8, S-37, and S-43. Repaired by replacing nut and using another nut for locking purposes by jamming it against the first.

No output from oscillator due to open oscillator tank capacitor C-63.

A continuity check with ohmmeter showed a very poor contact on switch S-9. After cleaning with crocus cloth and retensioning, the gear worked satisfactorily.

Found that the filament lead to the master-oscillator was grounding to the frame back of the oscillator compartment.

Found shaft of blower motor bent.

Tapping, h-f m-o coil would give readings. Tightened screws holding coil in place, bringing coil closer to variable capacitor. Transmitter then OK.

Found trouble in S-1, the h-f master-oscillator range switch. Tightened set screw of collar holding fiber shaft secure to metal shaft.

Found that high voltage generator field connection was loose, the intermittent contact producing inductive surges or changes in plate voltage thus causing failure of the protective devices.

Found spring on K-351D mechanically latched on the set screw bolting it to its support. Reset contact.

The roller on plate tuning coil had been removed in cleaning, thus changing the tunable range. Shifted roller to proper place.

Contacts of relays K-17 and K-18 sparked. Cleaned contacts and tightened springs slightly to make better contact. Trouble cleared.

Inspected brushes and replaced one 1,000-volt brush and one 250-volt brush, reseating all to neutral points to remove excessive sparking. Reversed shunt field properly, reversing shunt field and all d.-c. output connections for normal armature rotation. Operation then normal.

TBL SERIES TROUBLE SHOOTING NOTES--Continued

Difficulty Encountered

Motor generator fails to start.

250-volt MG bias supply fails to build up.

HV indicator lamp burns, but HV is not present.

HF MO screen current meter reads without transmitter being keyed.

2,000-volt MG supply fails to build up.

HF MO plate current meter reads without transmitter being keyed.

HF MO plate and screen current readings approximately right, but oscillator fails to put out RF.

Readings on HF MO oscillator dial wrong on all band ranges.

HF MO motor boats or breaks into spurious oscillations.

I-f MO fails to operate on all bands.

Filament of HF MO burns in standby condition but fails to operate when transmitter is operating.

I-f MO filament fails to burn.

I-f MO has spurious oscillations.

I-f MO fails to zero beat on 550 kc. band (will apparently come to a nul).

Not enough RF drive to first HF 1A.

Cause and Remedy

A. Interlocks S151 (in filter unit), S30, S29, and S28 not making contact properly.

B. Check fuses F3, F4 for continuity and supply voltage.

C. Check relays K13 and K16 for proper operation and their resistors.

D. Check links, A, O, F, and G.

A. Check bias supply voltage.

B. Check 1,000-volt supply at terminal 14 and then check meter.

C. Check over load reset K17 and K18.

D. Check for short in both HV and LV circuits in transmitter.

E. Check ground to K17 and K18 (check continuity to terminals 18 and 15 on terminal board).

F. Check resistor clip holder for contact between R13 and R18.

A. Relay K16 (B contact) is not closing the HV field circuit.

A. Check to see if keying relay K6 contacts is stuck.

B. Condenser C12 is shorted.

A. Check terminal 19 for HV and the HV voltmeter.

B. Check contacts of relay K16B (Field ckt to HV motor generator).

C. Short in HV supply in transmitter cause overload contacts to open or fuse F250 to open up.

D. Resistor R23 or M37 open, causing HV to build up and drop slowly to zero.

E. Wiper arm of switch S22 fails to make.

A. Check keying relay for proper operation.

B. Resistor R7 open or resistor combination R7, R6 wiring interchanged.

C. Check complete plate circuit of MO in transmitter.

A. Check grid for proper bias.

B. Condenser C6 (adjustment on front of panel) plates are shorted together because of improper adjustment.

A. Realign cylinder in coil L1.

A. Clean contacts and wiper in S1.

B. Check R5 (bias resistor) for proper tap.

A. Clean contacts and wipers S1.

B. Check C3, C4, C5.

A. Relay K11 contacts are bad or K11 fails to operate.

B. Switch S8 contacts fail to complete K11 circuit.

C. Check transformer T151 and fuse F150 (filter unit).

A. Check switch S8 for proper operation.

B. Check complete filament circuit.

A. Clean wipers and contacts S23.

B. Check R13 for proper value.

A. Check oscillator tank circuit condensers C61, C62, C63 (especially C61).

A. Check adjustment of C16.

B. Check value of C15, C18.

C. Check contacts of S4.

D. Check values tube voltages.

TBL SERIES TROUBLE SHOOTING NOTES--Continued

Difficulty Encountered

First HF IA does not tune at right place on dial.

NO RF or low drive to HF IA stage.

First HF IA I_p meter fails to dip at proper place on dial.

First IA plate current meter reads without transmitter being keyed.

Apparently not enough drive to 2nd HF IA stage.

Second HF IA I_p meter reads without transmitter being keyed.

Second HF IA stage fails to dip and operate properly on either 2-4 or 4-18 mc. band.

Not enough drive to HF-PA stage on 18 mc.

HFPAl_p fails to dip properly.

HFP A dips improperly on 18 mc. and goes in to self-sustained oscillations.

I-f PA fails to dip properly or dips intermittently.

I-f PA breaks down intermittently and circuit goes out of resonance.

HF transmitter fails to load.

HF transmitter loads improperly.

I-f transmitter loads improperly.

MCW audio oscillator tube filament fails to burn.

MCW audio oscillator has no output.

Cause and Remedy.

- A. Check alignment of dial and condenser C28.
- B. Check contacts and positions S9.
- C. Check C27.
- D. Check spacing of rotor and stator plates of C28.
- A. Check contacts of S10, S11.
- B. Check oscillator out put with neon bulb.
- C. Check tube operating voltages.
- A. Check dial alignment with L15.
- B. Check wiper contacts of S21.
- C. Check condenser C74, C75.
- A. Check condenser C99, C39.
- A. Check contacts S10.
- B. Check tube voltages.
- A. Check condenser C37, C76, and C79.
- B. Check IF-IA plate circuit.
- A. Check alignment of C36 and L16.
- B. Check contacts of S12.
- C. Check C35 and C37.
- D. Check condition of roller contact on L23.
- E. Check spacing of rotor and stator of C47.
- F. Check all tube voltages.
- A. Check setting of condenser C38 and C16.
- B. Check alignment C47 and L23.
- C. Check tubes operating voltages.
- D. Check contacts S13 and S16.
- A. Check alignment C47 and L23.
- B. Check RF by pass C48.
- C. Check positions and contacts of S13, S15, and S16.
- D. Check all tube voltages.
- E. Check condition of roller contact on L23.
- A. Check to see condensers C40, C43, C44, and C45 have grounding bond.
- A. Check contacts of S20.
- B. Check alignment of L22 and diameter.
- C. Check values of C84, C85, C86, and C87.
- A. L22 coil is breaking down between windings. Check winding for spacing and burned spots.
- B. Check C87.
- A. Check for loose bus bars.
- B. Check contacts S17 and S18.
- C. Check M13.
- D. Check C49.
- A. Check alignment of C51 and L25.
- B. Check C48 and C49.
- C. Check roller on L25.
- A. Check M12 and ground.
- B. Check alignment of L27 and dial.
- C. Clean and check contacts S19.
- D. Check S18 contacts.
- E. Check C91 and C95.
- A. Check contacts of switch S6 and S7.
- A. Check switch S4 and S5.
- B. Check C26.
- C. Check condition of T4.

TBL SERIES TROUBLE SHOOTING NOTES--Continued**Difficulty Encountered**

Transmitter fails to key.

Could not shut down motor generator at start-stop buttons either locally or at remote positions.

Frequency shifts as transmitter is keyed.

Cause and Remedy

A. Check for proper ground to S27.

B. Check all interlock switches S16A, S15A, S22A, S19A, S18A, S34A, and S20A.

C. Check relay K6 for continuity.

D. Check R38.

E. Check R29 for value and proper tap.

Traced trouble to link connected across S-44 terminals A and B. Ship used six wire remote control circuit which necessitates opening of link at S-44.

Dirty Contacts on oscillator band switch. Loose connections on oscillator coil. Clean contacts and tighten any loose connections.

MODIFICATION TO BLOWER MOTOR FOR ALL TBL TRANSMITTERS

The following beneficial suggestion concerning a method of reducing the failure of the TBL Transmitter Blower Motor has been received.

The Bureau approves the installation of a copper screen 4 inches in diameter over the motor fan. Type of screen recommended is 18 by 14 meshes per linear inch with a WIRE gauge of 0.011 inch in diameter. This eliminates the possibility of a screw or nut falling into the fan well, causing the motor to jam and burn out.

TBL BLOWER MOTOR LUBRICATION

Paragraph 6.45 of NAVSHIPS 900,373, Instruction Book for Radio Transmitting Equipment TBL states that the bearings of the TBL blower motor should be repacked in grease at yearly intervals. This has not proved satisfactory due to both the high temperatures in the area of the motor and the type of grease recommended. The use of Navy Grade--A-Soft Specification Number 14L3 or a similar type should be discontinued. It is recommended that a grease with a Lithium-Stearate base be used in its place. MIL-G-3278, a standard stock item, is recommended. MIL-G-3545 may also be used if specified as a Lithium-Stearate base.

TBL LINE-VOLTAGE SWITCH ON SUBMARINES

It has been pointed out that instances of MO Blower and Heater burn-out in the TBL equipment installed on submarines.

This trouble is the result of an excessive increase in TBL supplyline voltage during battery-charging operations and the failure of personnel to place the TBL Line-Voltage, Normal-High Switch in the HIGH position. It is recommended that maintenance personnel place warning instructions at battery-charging-switch-panels reminding the operator to place the TBL switch in the proper position.

MODEL PP-1211/U A.C. POWER SUPPLY FOR USE WITH TBL SERIES XMTR**W-A-R-N-I-N-G N-O-T-I-C-E**

The model PP-1211/U power supply furnishes ac and rectified ac power to model TBL radio transmitters originally designed to operate from a dc power source. Input voltages are 220/440, 3 phase, 60 cycles.

It has come to the attention of the Bureau of Ships that there is a safety hazard to personnel involved in the model TBL radio transmitter when connected to the PP-1211/U as shown in the PP-1211/U Technical Manual, NAVSHIPS 92861. The TBL safety--interlock circuits are inoperative as well as the local START-STOP switch. All maintenance and operating personnel are cautioned not to perform maintenance on the TBL until ON-OFF switch S-101 in the PP-1211/U is in the OFF position.

The Bureau of Ships is presently investigating this matter. All activities that have received the PP-1211/U are hereby warned of this malfunction. It is recommended that the PP-1211/U equipments not be used until proper corrective information or field changes are developed by the Bureau of Ships.

F.C. 7-TBL-5, -6, -7, -121-13 NAVSHIPS 981060 CALIBRATION INTO A 50 OHM LOAD

The Bureau has received reports from several ships, submarines and activities indicating difficulty in tuning the TBL-() when using an antenna tuner similar to the AN/BRA-3, AN/BRA-5 or AN/SRA-18 ().

Investigation has disclosed that activities installing this field change have not pre-calibrated the TBK-() output loading controls into a satisfactory 50 OHM resistive load. The field change bulletin provides SAMPLE charts to indicate loading adjustment.

It is the intent of the field change, that the installing activity tune and operate the TBK-() into a 50 OHM load (500 Watt) such as the DA-91/U and prepare calibration charts for the individual transmitter. THE CHARTS IN THE BULLETIN ARE ONLY REPRESENTATIVE and should not

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS**

be used for the field changed equipment. Dial and component shippages, minor circuitry differences, etc. will cause dissimilar readings to those shown in the bulletin,

The requirement for a preliminary 50 OHM calibration chart is also applicable to the forthcoming field change bulletins for TBK, TBM and TDE equipments.

The Bureau is currently investigating a more complex TBL-() modification, as proposed by USNUSL, that will enable the switching of the TBL output circuitry to match a 50 OHM load and to eliminate the requirement for a calibration chart and several tuning adjustment steps.

REMOTE CONTROL OF TBM-8 RADIO TRANSMITTING EQUIPMENTS

The remote control telephone unit, type 23304, supplied with the TBM is designed to voice-modulate the equipment from a remote point. It is possible for an operator at a remote point to start, apply carrier, and voice-modulate the equipment. However, it is not possible for the operator at the local or transmitter end. In order to effect automatic shutdown and certain other desirable features, the Bureau, working in conjunction with Westinghouse Electric Manufacturing Co., has developed certain modifications to the TBM. Modification kits will be prepared by the contractor and made available to all field activities concerned. Since the delivery date of all the above modifications kits is uncertain, the following method for effecting automatic shutdown is recommended.

(1) To obtain normal time delay and shutdown action (with S-405 in the modulator unit in voice position) remove the lead from terminal 43 in the CAY-50064-A modulator unit which makes the closing of contacts S-405F ineffective in shorting relay contacts K1B as described in paragraph 2-35 on page D-10 in the TBM-8 instruction book.

(2) To maintain the modulator unit in a condition of readiness during shutdown periods, and keep all filaments lit, the lead from center terminal 11 in the CAY-24084 transfer panel can be transferred to center terminal 10; this will energize the primary of the filament transformer in the modulator unit by bypassing contacts K-361-B in the CAY-21411 motor starter panel.

102 of the above controls have been shipped and are now available as follows: 52 FRAY-32, 50 EPIC-32.

EMERGENCY PARTS REPLACEMENTS FOR TBM AND TCM EQUIPMENTS

In view of the fact that considerable numbers of failures have occurred in the modulation transformers of TBM equipments and the fact that replacements are not always available, a Thordarson transformer, number T444-10, believed to have been removed from an Army Signal Corps set model RC-52 was substituted in two of our TBM transmitters and during its five months of service has been absolutely trouble free.

Although the original transformer in the equipment has two separate windings in the secondary, one for each of the modulator output tubes, the above-mentioned transformer has a center-tapped secondary. The plate current meters of the modulator output tubes were paralleled in series with

the center tap but could be put in the plate side of the secondaries and still give the value of current per tube.

Also having experienced difficulty in obtaining replacement tubes type 836 for TCM equipments, which are high-vacuum rectifiers, type 866 mercury vapor tubes were substituted and have proven very satisfactory as emergency substitutes, until type 836 rectifier tubes were available for replacement.

Steps have been taken to modify the defective TBM modulation transformers. The type 866 rectifier is a satisfactory emergency substitute for the 836.

FAULTY FUSES FOR TBM TRANSMITTING EQUIPMENTS

The Bureau has received information that several of the 1 ampere 5,000 volt, nonrenewable fuses (F-221) used in TBM transmitters did not have center links although the ends had been soldered. These fuses had been in spares and had not been used prior to test.

It is to be noted that over a period of time, the links in these fuses will deteriorate. It is therefore recommended that maintenance personnel check the spare fuses of this type periodically in order that good ones will be on hand at all times.

FAILURE OF CAPACITORS IN TBM-5 THRU TBM-9 EQUIPMENTS

A number of failures of capacitors C-403, C-405, C-415, and C-422 (Navy type 48852A) in TBM-5 through TBM-9 modulator units have been reported. Indications are that the voltage rating is too low. To alleviate this condition, a capacitor with higher voltage rating should be substituted. In case of failure of the old capacitors, the Navy type 482063 capacitor (1 mfd, 400 V) should be requested and substituted. These are available at major supply bases.

MARKING OF MOTOR-GENERATOR SETS WITH TBM-7 EQUIPMENTS

See the article of similar title in TBK series.

CONVERTING TBM TO A TWO-WIRE TRANSMISSION LINE SYSTEM

See the article of similar title in TBK series.

TBM SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Modulation and signal strength very poor.

No voltage on rectifier tube filaments, or control relay.

Heavy arcing on main power switch.

Cause and Remedy

Power-amplifier tuning condenser shorted by a sliver of metal. Removed and cleaned.

16-ohm resistor on generator's single-phase winding open. Replaced from spares.

Caused by accumulation of oil, dust, and paint chips. Disassembled front of rectifier unit, cleaned thoroughly and reassembled.

TBM SERIES TROUBLE SHOOTING NOTES--Continued**Difficulty Encountered**

Overload relay trips.

No carrier control.

No remote voice control.

Master-oscillator heater relay stuck.

Master-oscillator dial coupling slipping.

TBM-7.--Transmitter performing poorly with low drive on the 2,000-4,000 kc. band. Working normally when band change switch is in the 4,000-18,000 kc. position.
TBM-4 and TBM-7.--Excessive play in tuning controls.

TBM-7.--Frequent failures of screen bypass condenser (C-403) CAY-48852-A in modulator unit CAY-50065-A.

TBM-7.--Each time the selector switch is thrown to the PHONE position, the high-voltage fuse F-222 blows. The transmitter works normally on CW.

TBM series.--Failure of capacitors C-403, C-406, C-415 and C-422 in modulator type CAY-50065.

TBM-8.--Blowing of high-voltage fuses.

Blowing of high-voltage fuses.

Blowing of high-voltage fuses.

No carrier.

TBM-6.--High-voltage field rheostat R-33 did not control the generator output voltage when rotated.

TBM-7.--Equipment would not key. Voltmeter readings were apparently correct.

TBM-4.--Power-amplifier ammeter M-2 indicated excessive current, reading between 400 and 500 milliamperes.

TBM-4.--The transmitter was not staying on frequency, was wobbling, and a bad note was reported.

Cause and Remedy

Bypass condenser in p-a plate circuit shorted. Replaced from spares.

Renewed points on voice control relay.

Relay coil in relay K-401 open. Replaced from spares.

Dressed points.

Set screws backed out from vibration. Removed master-oscillator unit, tightened set screws, cleaned contacts and replaced.

Replaced C-53. Normal operation resulted.

This is caused by loose taper pins in the shafts and set screws of flexible insulated coupling. Remedied by replacing flexible coupling screws with 6/32 machine screws, lock washers and nuts.

The voltage rating of the condenser was too low. It was replaced with a commercial condenser of the same capacity but rated at 400 volts.

Investigation showed that the modulation transformer T-405 was arcing to ground inside lead-thru insulators on terminals No. 1 and No. 3. This condition was overcome by removing the mounting bracket, then bending the end on which terminals No. 1 to No. 4 are mounted 180°. This reversed end was then used to mount a Bakelite strip measuring 3" x 5" x 1/4". This strip projects above the transformer frame in the position of the original bracket. Terminals No. 1 to No. 4 were mounted on this Bakelite strip.

In view of the large number of failures of Navy type 48852A capacitors in the TBM series of equipments, it is recommended that in the case of future failures of this type of capacitor, regardless of circuit application, the Navy type 482063 capacitor with twice the working voltage be requested and substituted in lieu of type 48852A.

Step-down transformer T-14 breaking down internally and shorting to core. Rewound and reinstalled.

Condenser C-420 in modulator shorting to ground. Replaced. Modulation transformer T-405 breaking down. Rewound and reinstalled.

Carrier control relay K-401 burning out. Replaced.

The trouble was traced to an open circuit between three contacts of one unit of this resistance. Temporary repairs made by shorting out dead contacts with solder to give continuous circuit through rheostat.

Wear of the contact strip of S-2A had reduced the contact pressure to a point where a continuous open circuit resulted. Restoring the contact action placed the gear in satisfactory operation.

Grid bias lead from the motor-generator set was shorted to ground behind the large terminal board at the base of the transmitter. This was caused by a metal link from another terminal position on the board touching it. This link was returned to its original position and operation again was normal.

Caused by master-oscillator range switch not making good contact. After the contacts were cleaned, the set operated normally.

TBM SERIES TROUBLE SHOOTING NOTES--Continued**Difficulty Encountered**

Failure of C-403, 1-mfd., 200-volt, Navy type 48852A.

TBM-9.--Overload relay kicked out every time the start button was pressed.

TBM-7.--Oscillator would vary in frequency over a range of several hundred cycles when transmitter was keyed.

TBM-7.--Frequent blowing of fuse F-211.

TBM-7.--Very low modulation (20 percent) with 150 mils plate current in modulator tubes.

TBM-11.--Coil L-20 burned out.

TBM-7.--Transmitter inoperative. M.O. Screen grid current meter, M-8, indicated with key either up or down. All other stages dead.

TBM-8.--The TBM-8 transmitter serial 171 failed to key on the first six steps of the MO range switch. Steps 7 and 8 keyed normally. After rotating the switch through steps 1 through 8 the transmitter keyed on steps 6, 7, and 8.

TBM-7.--No filament voltage applied to power amplifier tube in the high-power switch position.

Cause and Remedy

For replacement use type 482063, 1-mfd., 400-volt. This also applies to C-406, C-415, and C-422.

Found dashpot of relay K-824 dry. Refilled with proper oil and no further trouble was encountered.

Found to be due to dirty contacts in master-oscillator range switch S-1A and S-1B. Dirt apparently caused by carbon from blower motor B-1. Repaired by cleaning contacts.

Found to be due to leaky C-47 with a d.-c. resistance of 300,000 ohms across the terminals of the capacitor. Replaced C-47 and no further fuses blew.

Found to be due to leakage in capacitor, C-408. Normal operation restored (100 percent modulation) when capacitor was replaced.

Caused by link AB not being removed, thus leaving the transmitter set for both 4- and 6-wire control.

Test M.O. tube and replace if necessary. If trouble still persists, remove M.O. tube and apply power. If meter continues to give reading, check bypass capacitor, C-6, for resistance to ground. Replace if defective.

Switch S1C was checked and was apparently making good contact. After checking all parts of the circuit S1C was removed. The contacts were dressed, bent slightly and the switch replaced. The transmitter now works properly on all 8 positions of the range switch.

It will be noted that S1C is in the keying relay circuit and that when it is not making good contact the keying relay will not close.

P. A. filament switch S-3B inoperative due to frozen movable contacts. Freezing was due to switch being off center in relation to the mounting plate causing the two elements holding the movable contacts to bind. Replaced switch S-3B for normal operation.

OSCILLATOR FAILURE IN TBS SERIES RECEIVERS

In certain TBS series receivers, difficulty may be experienced in receiving signals at the low-frequency end of the range. This condition is apparently caused by crystal failure, but the actual trouble has been ascertained by the contractor to be due to an absorption circuit formed by the two capacitors, C-444 and C-445, and the inductance of the lead connecting them. It may be remedied by replacing the lead with a 270-ohm $\frac{1}{2}$ -watt resistor, R-457. Attention is invited to the fact that the 270-ohm resistor required will be found in the spare parts box under the designation R-457. Another 270-ohm $\frac{1}{2}$ -watt resistor should be requisitioned through regular channels to replace the one used for the modification.

It is desired that this modification be made at the earliest opportunity. It has already been made at the factory in some TBS-3 equipments so that no modification need be made in equipments which have R-457 installed. Receiver crystals should not be returned to the contractor as defective unless found to be so by actual test in an equipment already modified.

ANTENNA FITTING FOR TBS ANTENNAS

In cases where the TBS antenna is located in such a position that it is subject to strong vibration when the ship is underway there is the possibility of breaking of the connection between the bronze plug in the lower portion of the antenna and the antenna tubing. In the original construction of the antenna the lower portion consists of a bronze plug which projects three quarters of an inch into the copper tubing of the antenna proper. The contractor has changed the design to provide a better joint between tubing and plug. This change consists of enlarging the plug to fit over the outside of the tubing instead of inside, thus providing a greater adhering surface for the solder which holds the two parts together.

Failures due to breakage of the connection between the rod and the original design plug can be overcome where facilities are available by silver soldering the joint between plug and tubing. An alternative method is to substitute a similar plug which projects into the antenna tubing for a distance of seven inches. Figure 1 shows the dimensions of the fitting.

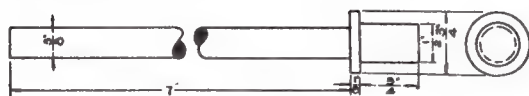


FIGURE 1.--Dimensions of the fitting

MODIFICATION OF TBS ANTENNA SUPPORT

The Bureau has been advised of a defect in the installation of TBS antennas on the APA-151 to APA-235. In these vessels, the TBS antenna is supported by a section of 2" standard pipe fitted with a stuffing tube at the upper

end and a pipe cap at the lower end. It has been found that water leaks past the stuffing tube and collects in the lower part of the supporting pipe. The water rises up through the vent hole in the lower section of the TBS antenna thus changing its electrical length with the result that proper loading of the transmitter is impossible on some frequencies.

The difficulty may be corrected by removing the pipe cap and drying out the inside of the support, repacking the stuffing tube and drilling a $\frac{1}{4}$ " drain hole in the pipe cap. All ships encountering this difficulty should make this correction at the first opportunity.

TUNING OF TBS RECEIVERS

At times radio personnel get into the habit of tuning TBS receivers by the signal from the associated transmitter. This practice should be discouraged as it results in poor tuning of the antenna, link, and detector circuits with a resultant loss in sensitivity.

These circuits are best tuned with random noise and should be rechecked again after turning the silencer control on.

KEYING OF TBS SERIES EQUIPMENTS

Heretofore the Bureau has directed that no telegraph keys shall be installed and no means shall be provided for the operation of TBS series equipments on A_2 emission. Recent advices from the fleet, however, indicate that keying of the TBS equipment has definite advantages under certain operational conditions. Where keying of this equipment is desired, it is satisfactory to the Bureau to install a type 26012 telegraph key adjacent to the TBS remote unit or to connect the proper terminals from the transmitter terminal board to the R-RT (CW) transmitter patching panel where operation from standard operating positions is required. Knockouts on the side of this unit provide for passing type MHFA2 cable for this purpose. The key terminals must be connected to terminals nos. 2 and 4 in the remote control unit.

In using the telegraph key, the transmitter is tone-modulated and keyed for m-c-w operation. Upon pressing the key, a series of relays are operated to transfer the antenna from the receiver to transmitter, apply plate voltage to the transmitter tubes, and apply a modulation tone of 1000 cycles to the audio input stage of the transmitter. The carrier remains on after the key is first closed and the key thereafter controls only the tone modulation. Should the key remain up for more than approximately one second, however, the carrier will be cut off automatically and the equipment returned to the condition of reception. During transmission, the receiver serves as a monitor and side tone will be heard at all points of audio output; that is, from the loudspeaker, from either hand set, or from headphones connected to the chest set, control units or receiver panel.

In view of the limited requirements for the above facilities, keys will not be installed in new construction

vessels by the building yards, but should be installed by the ship's force when operational requirements indicate the necessity therefor.

SERVICING OF THE TRANSMITTER UNITS OF THE TBS SERIES EQUIPMENTS

Considerable difficulty has been experienced in servicing TBS series transmitters due to the construction of the equipment which prevents viewing of the relay operation and measurement of voltages while the transmitter is in operation. The TBS transmitter is constructed on a horizontal chassis which slides into an enclosing metal case. "Banana" type plugs mounted on a connection board on the chassis fit into corresponding jacks on a connection board mounted in the case.

In order to remedy the above situation, the New York Navy Yard has developed a portable patch cord which permits servicing under normal operating conditions. The device consists of two bakelite terminal boards, both mounted on individual movable weighted foundations and permanently interconnected by approximately six feet of flexible insulated cable, both exact replicas of the two boards attached to the case and to the transmitter chassis. The alignment of the two movable boards with the two permanently fixed boards must be exactly and perfectly

made. The banana plugs mounted on one of the terminal boards and the banana jacks mounted on the other terminal board are arranged to fit into the corresponding fixed jacks and plugs in the transmitter case and chassis. The terminal board on the transmitter chassis should be plugged into the movable replica of the transmitter case terminal board. The movable replica of the transmitter chassis terminal board should be plugged into the terminal board on the transmitter case.

In view of the continuous use of the TBS and the resulting necessity for proper maintenance and hasty repairs, it is recommended that similar "servicing cables" and "terminal board sets" be built by all requiring activities.

Components required, and listed by instruction book symbol designations, follow:

Symbol Designation	Function	RCA Drawing Number
E-105	Terminal board assembly for the transmitter.	P-717250
J-101	Jack for E-105	K-99015
P-101	Plug connector for E-105	K-99025
E-120	Terminal lug for E-105	K-30042
E-122	Terminal lug for E-105	K-811691

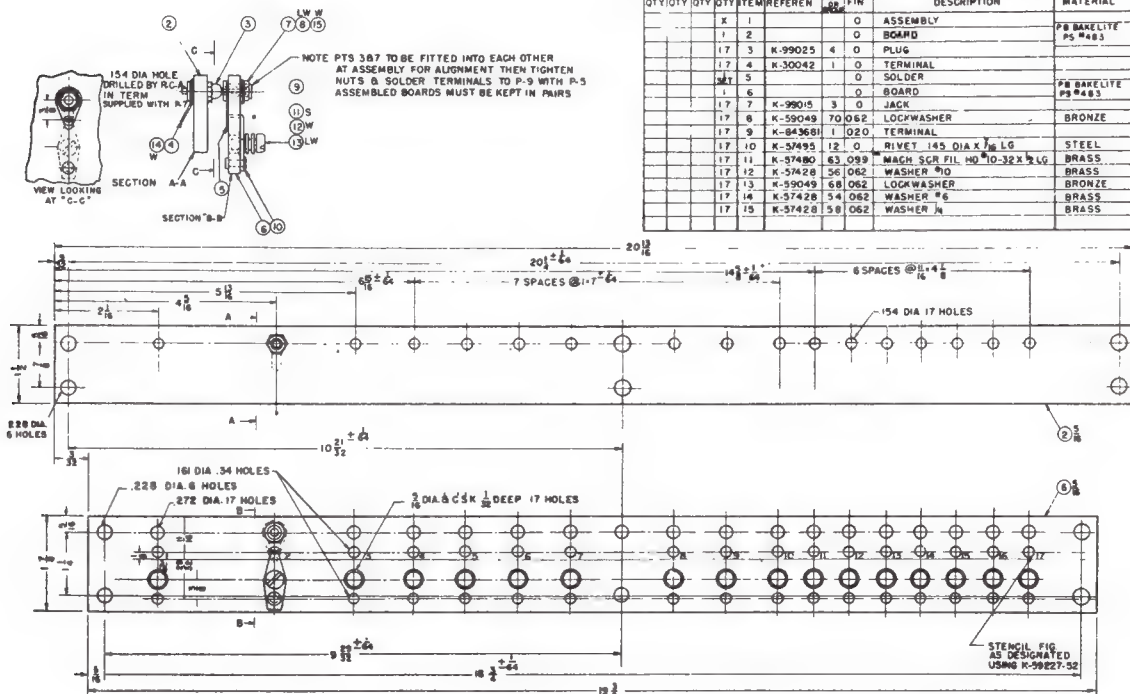


FIGURE 1.--Dimensions and data for the terminal boards for servicing TBS transmitter units

Refer to the technical manual for complete description and usage. A drawing of the terminal boards and accessories giving actual dimensions and complete data is printed herewith as Figure 1. The various necessary parts, if not on hand, may be requisitioned from the nearest RMO or supply depot.

RF FILTER CHOKES L-407 AND L-408 IN TBS EQUIPMENTS

Breakage of connection lugs to r-f filter chokes L-407 and L-408 during removal of receiver chassis has resulted

in instances where these lugs have not been provided with sufficient clearance from the receiver housing. A visual inspection of all TBS series equipment installed should be made to determine if these lugs are cleared during handling of the receiver chassis. Greater clearance may be provided in some cases by bending the lugs closer to the choke case. Adequate care should be taken to preclude damage to the chokes in accomplishing this preventive maintenance.

TBS SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

TBS antenna ground rods become loose due to vibration.

Motor-generator fails to start.

Overload relay kicks out.

Carrier comes on but no modulation.

Carrier on continually.

Speakers on flag bridge out.

Feed-back from pilot house caused howling when handset was used.

Power pack operation normal but on motor-generator operation, hand and chest set microphone buttons inoperative.

TBS-3.--Transmitter would not load properly into antenna. Receiver operation was normal.

Shock of gunfire causes handset to fall off hook.

Line starting relay closes due to shock of gunfire.

Keying transmitter causes interference in other receivers due to relays operating.

Feed-back howl when transmitter is keyed.

Transmitter keys at test switch 'S-101, but will not key from remote positions.

Antenna ammeter M-102 jumpy.

Unable to turn transmitter off. Starter resistance running red-hot.

Receiver will not pick up signals.

Receiver badly distorts signal and has "running motor" sound with noise suppressor OFF.

Cause and Remedy

This condition is caused by the ground rod vibrating loose from the securing pin or loosening of the securing screw. This trouble can be corrected by pinning the ground rod to the head of the securing screw, using a pin about one-sixteenth inch in diameter and also drilling the threaded portion of the securing screw for a cotter pin. This modification prevents both difficulties.

Leather in suction pump in motor starter too stiff, causing cup to lose suction thus starting motor too fast and overloading circuit. Loosened leather and adjusted for proper per suction.

Readjusted for voltage and returned transmitter.

Defective microphone cord. Replaced.

Relay in control unit in flag radio out of adjustment. Readjusted relay.

Volume controls in position exposed to weather--corroded and frozen. Cleaned volume controls, adjusted and replaced.

Control unit relay not closing, which allows speaker to operate during transmission. Adjusted relay.

Test switch on transmitter operates equipment normally. Found tension on relay K-104 slack. Adjusted relay. Operation normal.

The antenna transfer relay K-103 was not making proper contact when energized. The trouble was cleared by adjusting the contacts.

Original type holder may be modified by adding a coil spring or rubber strap in such a manner as to lock the handset in place.

The armature of the line starting relay was weighted with thin sheets of lead to prevent accidental closing due to shock of gunfire or heavy vibration.

Check grounding of floating receiver chassis. Good ground is necessary.

Muting relays in remote units improperly adjusted.

Spring tension of K-104 relay too tight.

Clean and check contact of K-103 relay.

One side "start-stop" line grounded. Removed ground.

Check 956 tube. If found shorted, check resistor R-404.

Screen grid of first detector tube shorted to ground.

TBS SERIES TROUBLE SHOOTING NOTES--CONTINUED

Difficulty Encountered

Press-to-talk button must be depressed at least partially to receive, and must be released to transmit.

Bridge speaker cut out when start button was depressed. Check showed transmitter shifted to m-c-w for a second or two after start button was pressed.

Failure of type 5Z3 rectifier tube in TBS receiver.

Failure of power transformer in TBS receiver.

Antenna connection between receiver and transmitter failed

Antenna relay failed.

TBS-2.--Failure of 956 tube and R-404.

A metallic deposit was collecting on the ceramic insulators located in each end of the flexible transmission line connecting the transmitter to the transmission line terminating box.

Faulty operation of push button on handset.

Receiver exhibited severe fringe howl when receiving modulated signals.

Symptoms

- (1) Input meter goes off scale when input switch is placed in position 1.
- (2) Excessively high setting of noise suppressor control is needed to effect cutout of noise.
- (3) Failure of a-v-c time control to have effect on signal level.
- (4) Excessive interaction of antenna, link and detector controls and apparent double tuning of doubler controls and detector control.

Cause and Remedy

Check handsets for defective factory wiring.

(Note: Defects in the wiring of TBS handsets have been reported frequently and should be sought when trouble is experienced on new installations.)

Replaced carrier control tube, 6A6. This cut-out action was natural but period was too long.

The modification described on page 1 of TBS series will eliminate this difficulty.

If another type 5Z3 is not available, a temporary repair may be made by substituting a type 80 tube. The receiver d-c plate current drain is 65 milliamperes which is within the rating of the type 80. The only noticeable difference will probably be a slight reduction in the d-c output voltage.

Temporary repair may be made with transformer type CNA-30883 used in models RAO and RAO-1. Electrical characteristics of this transformer are almost identical with those of the TBS transformer. Appropriate mounting of the RAO transformer must be made when installing.

This was found to be due to excess vibration. The wire was lengthened inside the shield and heavier lugs were installed on ends of wire.

One of the bolts which fastened antenna shield to the cabinet protruded through the panel enough to push relay bracket up, thereby grounding the receiver antenna. The screws were shortened and bracket straightened to correct angle.

When installed, the 956 tube in the receiver was put in backwards causing it and the associated R-404 resistor to fail.

Caused by rubbing of the insulator against the adjacent metal ring which does not put up tightly against the insulator, allowing the insulator to move under vibration. Bevel the inside edge of the nut with a hand scraper to remove about one thread. This will allow the nut to tighten up sufficiently to hold the insulator firmly in place.

Some of these handsets were installed with all wires connected correctly except the black wire from the receiver; this was erroneously connected to the top push button contact (nearest the cover) instead of to the center contact. To correct the wiring, remove this one wire from the top contact and connect it to the center contact.

Replacement of condenser C-456 remedied trouble.

After prolonged tests a conclusion was reached that the a-v-c circuit was not functioning properly. As the check of components had revealed all to be normal, a grounded a-v-c bus was the only solution. Due to the high resistance included in this circuit the first inspection had not revealed such a ground. The final inspection revealed that the ceramic insulator passing through the chassis in the r-f subchassis compartment, marked "terminal 5", at the junction of C-465 and R-401, had been broken and had allowed the machine screw to short to the chassis thus grounding the entire a-v-c circuit. The input meter

TBS SERIES TROUBLE SHOOTING NOTES--CONTINUED

Difficulty Encountered

(5) Distorted audio output.

Receiver--erratic indication of meter M-401.

Intermittent reception --usually cut off entirely, and high static level.

Excessive noise and intermittent reception in receiver along with intermittent modulation when transmitting. Acoustic feedback occurring when two or more remote positions, with loudspeakers, were installed.

TBS-3.--Intermittent cutting out of received transmissions which seemed to correspond to vibration of the ship. Overload relay in transmitter kicked out for no apparent reason. Abnormal fluctuations in power-amplifier plate current were noted.

TBS-2.--Sensitivity low on all operating frequencies.

TBS-2.--Sensitivity low. Intermittently would cut out; other times severe noise indicating loose connection.

TBS-2.--Receiver intermittently would go into an oscillating condition; either high noise level or signal input would cause this.

Receiver broke into oscillation when detector, link or or antenna controls were adjusted.

TBS-3.--Overload relay operates whenever transmitter is keyed.

TBS-3.--Transmitter modulation very weak and accompanied by 1000-cycle note.

TBS-3.--No output from receiver; plate voltage only at last stage.

TBS-3.--Transmitter was keyed whenever motor-generator was running; press-to-talk button was not actuated.

Cause and Remedy

had "pegged" as a result of insufficient grid bias on the r-f amplifier tube. This in itself is a good indication of the location of trouble. Replacement of the insulator completely removed all of the difficulties.

Look for loose connections at M-401 and the associated ground switching terminals. Note that the defective circuit can be isolated by determining the position of S-403 in which the erratic behavior occurs.

Antenna coaxial lead shorting to ground at receiver terminal box due to physical looseness of lug on insulator post and also general detuning of receiver.

Antenna switching relay K-103 making poor contact.

Hand telephone sets were incorrectly wired thus energizing the microphone whenever the transmitter was on, while earpiece was energized only when the press-to-talk button was used. Handsets may be checked for this condition by continuity testing between terminals 1 and 4 of handset plug. If correctly wired, 1 to 4 will read 35 to 50 ohms when press-to-talk button is actuated and infinite at all other times. If the above is not so, interchange two black leads at the press-to-talk button within the handset.

An intermittent short was discovered in the coaxial cable where it goes into the junction box that joins the gas-filled transmission line.

Realigned i-f circuits.

Contacts of antenna switching relay dirty. The grounding contact on TRANSMIT was not grounding the receiver antenna. Increased the tension by bending the contact arm.

Investigation revealed that the r-f amplifier was at fault. Various tests revealed no apparent circuit trouble. The r-f amplifier tube was tested and proved good; however, this tube was replaced with another manufactured by RCA and it was then impossible to make the receiver oscillate as before. Raytheon and Tung-Sol tubes were both tried in the circuit with the same results. Our second TBS receiver is not affected in this manner.

Replaced V-401 type 956 tube made by Tung-Sol with 956 made by RCA. Operation normal.

Antenna transfer relay K-103 out of adjustment, causing plate voltage to be applied to tubes before the antenna was connected to the transmitter.

Connection # 16 on transmitter terminal strip loose.

Caused by open section of filter choke L-406-B. As a temporary measure, reception may be restored by connecting a jumper wire between terminals #2 and #3.

Green lead to terminal # 2 on chest set jack J-202 of remote unit became disconnected and touched ground thus completing keying circuit.

TBS SERIES TROUBLE SHOOTING NOTES--CONTINUED

Difficulty Encountered

TBS-3.--Receiver weak. Had to be run with noise suppressor off and full audio gain.

TBS-3.--Weak audio output, fringe howl when audio gain was advanced, d-c output voltage from rectifier dropped from 250 volts to 180 volts, and poor response at low audio frequencies.

TBS-3.--No signals when model PD-1 voice recording equipment was attached to receiver.

Sensitivity of receiver very low. All meter indications normal.

Overload relay kept kicking out.

Weak signals (modulated or otherwise) and a continuous chirping were received. In addition, incoming signals were blocked.

TBS-2.--Weak, distorted signals received. The radio-frequency ammeter reading was erratic. When tuning the final amplifier, the maximum plate current reading was obtained at resonance. The tuning indications were with an unneutralized amplifier.

TBS-3.--Fuses in receiver and fuse box burned out.

TBS-3.--No plate voltage on transmitter.

TBS-3.--The r-f amplifier was oscillating; usual remedies had no effect.

"Gets out" OK, but can't hear any stations unless they are almost alongside. All parts apparently operating normally and checked OK.

Cause and Remedy

Checked voltages, all OK. Checked i-f alignment, found i-f amplifier peaked on 5.15 mc. instead of double humped on 5.3 mc. Realigned i-f amplifier in accord with instructions, operation then very satisfactory.

Found power supply filter capacitors C-455 and C-456 to be "open." Replaced 30-mfd. 450-volt electrolytics and operation normal.

Found that TBS-3 receiver output transformer secondary was grounded on opposite leg of circuit in relation to input transformer of model PD-1 equipment. Normal operation restored by changing ground on TBS-3 output transformer.

Reduced plate voltages noticed. Failure was traced to the power supply. Condenser C-455 in power supply was replaced. The voltages immediately were raised 50 volts and the receiver was operating normally.

The tripping of the overload relay was due to the increase in the final plate current. This was due to the grounding of the concentric line, from the transmitter to the antenna jackbox, to the sleeve of the box coupling, causing the transmitter to get out of resonance. Two isolantite beads were added to the concentric line at the lug end, thus keeping the line from touching the sleeve. After retuning the transmitter, the equipment operated normally.

Failure resulted from the shorting of screen bypass condenser C-429. When the condenser was replaced, the equipment functioned satisfactorily.

Chassis connection bus bar # 28 which is the 2nd doubler condenser to ground connection, made poor contact at the chassis. The ends of the bus bar and the chassis itself were cleaned. The holding contacts for the bus bar on the chassis were tightened and secured.

Tested plate circuit and found it to be shorted to ground. Elimination tests made and found rectifier filter capacitor C-455 to have an internal short. Replaced the bad fuses and C-455, and unit was restored to normal operation.

High-voltage brush on 875-volt positive lead arcing considerably. Brush holder insulation discovered to have broken down, when checked by point-to-point tests. Arcing had caused low-voltage field to overload and blow bias field fuse. Water leaking on the brush cap had caused the arcing. It is suggested that insulated washers of bakelite or hard rubber be placed under all brush caps to prevent future damage from moisture.

Added 10-ohm ½-watt resistor in series with the grid of V-401, connecting it between the grid and C-401. Complete stability was attained.

Investigation showed that the antenna changeover relay was not making contact in the RECEIVE position. Took short piece of wire and "jumped" it from the antenna to the receiver, resulting in perfect reception. Then opened up the change-over relay and made the necessary screw-driver adjustment to insure that good contact was made in the RECEIVE position. Most reports of poor reception can be traced to a defective or weak 956 r-f amplifier.

TBS SERIES TROUBLE SHOOTING NOTES--CONTINUED

Difficulty Encountered

Transmitter could not be "shut down."

No transmitter output.

No receiver output.

Unstable transmitter output.

TBS-2.--Receiver would break into oscillation whenever the detector, link, or antenna controls were tuned.

No reception on receiver; almost impossible to tune the transmitter when antenna was connected.

TBS-2.--"Chirping" in receiver when transmitter was in operation.

TBS-2.--When the transmitter was modulated from the open bridge, feedback occurred.

TBS-3.--Receiver dead.

TBS-3.--Transmitter would key the instant that the motor-generator would get up to speed. Could not modulate the transmitter.

TBS-3.--Transmitter failed to key from remote control station; operation normal at transmitter.

TBS-3.--Speaker remained connected when press-to-talk button was actuated, thus causing feed-back and howling.

TBS-3.--Oscillation in receiver.

Cause and Remedy

Inspection of remote station disclosed that the ON push-button switch on the bridge had shorted out, due to dampness. The switch was wiped dry, cleaned, and repaired. The set then operated normally.

"Fingers" on relays K-101 and K-103 were not making good contact. Adjusted relays and cleaned contacts on antenna transfer relay K-103 and equipment operated normally.

Antenna transfer relay K-103 was sticking. The relay was adjusted and no further trouble was experienced.

Oscillator coil L-101 was checked and turns found improperly spaced. Turns respaced, and the equipment operated normally.

It was found that replacing the type 956 r-f amplifier tube, V-401, cleared up the trouble. Incidentally, a tube tester will not locate this type of trouble, which is due to a manufacturing defect in the tube.

Found to be due to moisture in the coaxial transmission line. The trouble was located by holding the key down for a few minutes and feeling the coaxial line for warm spots indicating the location of points of loss. The coaxial line was opened and dried out, after which normal operation was resumed. As an emergency measure during the period when the TBS antenna system was being repaired, the VHF antenna and coaxial line were used with the TBS.

Found to be caused by defective filter capacitor C-456.

This failure was traced to the remote position in the CIC. Upon inspection of the handset, Navy type 51019, a strain of wire was found to be shorting the grounded switch contact to the microphone switch contact. This meant that the microphone circuit was completed at all times; the keying circuit, however, was normal. Therefore, when the transmitter was modulated from the bridge, feedback occurred between the CIC microphone and the loud-speaker.

The screw holding the receiver terminal of the transfer relay K-103 was grounding intermittently to the screw holding the relay in place. As there was about 5/16" of thread showing after the relay holding screw was tightened, about 1/8" of the screw was ground off, thus providing clearance and allowing normal operation.

Found lead from remote control terminal # 13 to transmitter terminal # 16 grounded.

Found spring tension on relay K-104 too strong. Reduced tension by means of thumb screw adjustment.

Found that relay K-201 was not closing properly. Readjusted contacts and decreased spring tension.

Voltage check showed normal conditions. Trouble was traced to R-404 which showed 10,000 ohms when hot instead of 1200, and C-19 which had a 1-megohm leakage resistance. Both parts showed normal values when cooled. Trouble completely eliminated by replacement of R-104 and C-19.

TBS SERIES TROUBLE SHOOTING NOTES--CONTINUED

Difficulty Encountered

TBS-4.--After installation of new antenna rod found that power-amplifier plate current failed to dip more than 3 ma. and dipped at a radical dial setting.

TBS-5.--Erratic operation of keying relay when using m-c-w (A_2) emission.

TBS-5.--Equipment would not operate. A loud 60-cycle hum in the output of the receiver was heard.

TBS-5.--Receiver noise higher than usual. Reception intermittent.

TBS-5.--Receiver picked up interference from model SL radar.

TBS-6.--Receiver would cut out after several hours normal operation.

TBS-4.--Push-to-talk button fails to operate transmitter.

TBS-5.--Considerable decrease in audio output with only slight reduction on tube socket voltages.

TBS-6.--High reading of input meter on position 3. Low noise level and low reading on output meter.

TBS-3.--Erratic action of AVC noted by fluctuation of input meter when switch was in position A. The bias on the r-f amplifier tube was measured with a vacuum-tube-voltmeter and it varied from -2.2 volts to -1.4 volts.

TBS-5.--Intermittent operation of transmitter with varying plate current in final amplifier and overload relay kicking out.

TBS-3.--Receiver would go completely dead and a slight jar or shake would cause it to operate for a few hours before going dead again. If the meter switch was thrown to position #3 (crystal oscillator cathode current) the receiver would start operating again.

TBS-2.--Receiver had intermittent, evenly timed noise.

TBS-5.--Severe interference present in receiver whenever motor-generator set was turned on.

Cause and Remedy

Found that the socket into which the antenna rod was placed was oxidized and not making good contact with the rod. Trouble was completely eliminated by cleaning the socket walls and the antenna rod with crocus cloth.

Found voltage output from generator to be low. Readjusted speed regulator.

Faulty electrolytic condensers in the filter circuit are usually the cause of this hum. The capacitor, circuit symbol C-442, in the d-c power filter was "open." Its capacity had decreased considerably.

Plunger contact on K-103 failed to free the receiver antenna input from ground on RECEIVE position. The intermittent reception was caused by dirty "antenna to receiver" contact. The other cause of the high receiver noise was a loose lead-in through the receiver chassis.

Found that the shield of the flexible section of the transmission line was not properly grounded at the connection box to the gas-filled section of the transmission line. Proper grounding completely eliminated the interference.

Tubes checked perfectly. Voltage measurements failed to isolate trouble. A small wire within oscillator coil L-401 was found to be expanding when heated and shorting a small fixed capacitor enclosed in the coil. The painted surface of the capacitor had worn off rendering it vulnerable to short circuits. The capacitor was replaced and the receiver resumed normal operation.

Due to decrease in resistance of R-131.

Found C-442 open. Replaced.

R-432 increased in value from 100 ohms to 170,000 ohms.

This resistor is in the cathode circuit of the second audio amplifier stage.

Found defective capacitor C-421. Bias voltage was steady at -2.2 volts after replacement of this capacitor.

Found to be due to loose mechanical coupling of the flexible coaxial line and the transmitter terminal. The clamping screw was tight but did not clamp the cable to the terminal. The antenna was removed and an additional insulating washer was inserted. This cleared up the trouble.

New oscillator tubes did not help. The meter switch was left in position #3 and the next time the receiver went dead it was noted that the meter reading increased showing failure of the oscillator to oscillate. The crystal was replaced (Y-401) and the gear has operated satisfactorily since.

This was found to be caused by a poor ground connection between the transmitter and receiver. Cleaned the connections and tightened bolts and resumed normal operation.

All power supply filter capacitors were tested and found to be OK. Checked brushes of motor-generator set and found them badly nicked and scratched. Replaced all of them. Cleaned carbon dust from between commutator segments and interference was completely eliminated.

TBS SERIES TROUBLE SHOOTING NOTES--CONTINUED

Difficulty Encountered

TBS-5.--Receiver would cut out intermittently and, while it was out, excessive noises were heard.

TBS-4.--Interference produced in low frequency equipment when transmitter was keyed.

TBS-1.--Receiver operating very poorly; input meter fluctuating on position 3.

TBS-5.--Intermittent operation of receiver--signals very good and then very poor.

TBS-3.--No audio output from one of the remote units.

TBS-6.--The receiver operated fairly well but with a slightly decreased output. The transmitter would not get through to neighboring control stations although it tuned up properly. Trouble was suspected in the transmission line.

TBS-3.--When transmitter was keyed on the TUNE step, the modulation meter needle hit the peg and did not return until the test switch was released. The condition occurred only on the TUNE position.

TBS-5.--No reception. Unable to tune oscillator. With S-403 in position 3, the needle of M-401 vibrated.

TBS.--Transmitter keyed continuously.

Cause and Remedy

Found that choke L-406 was leaking oil over the chassis. Replaced and no further difficulties encountered.

Cleaning of keying relay had no effect. Ground braids from transmitter to receiver were tightened and from transmitter to ship's frame were cleaned and tightened. This eliminated the interference.

Found poor connection between transmitter and receiver, the shield at the antenna connection not being clamped on tightly enough. Found M-401 fluctuating because the bolts in socket X-404 were loose causing the shield around V-404 to be improperly grounded. Also found a cold solder joint at the cathode of V-403.

Antenna was found to move the insulator where transmission line joins antenna. Found connection very dirty. Cleaned and retightened--all OK.

When unit was removed from its cabinet the output was normal. When unit was replaced in cabinet, the unused terminal of J-203 grounded out on the case. Bent lug upward to clear case and operation returned to normal.

A soldered connection in the transmission line approximately 8 inches above the junction box had become unsoldered. This connection is not mentioned in the preliminary instruction book for this gear. When this joint was remade the trouble cleared up.

It was found that R-138 had been damaged during the removal of the transmitter from its case. Replaced.

Only 2 volts on the heater of V-403. T-409 very hot.

Heater wire was found to be shorted to ground through worn insulation.

Replaced tube 6A6, V-111, which had low emission. As the transmitter keying relay is held in the receive position by the 6A6, plate current, low emission in the 6A6 will result in continuous keying.

TBW SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

No first i-a grid current. Keying relay K-301 not making contact.

Failure of keying relay.

Cause and Remedy

Inspection revealed armature and isolantite contact holder severed. Threaded end of armature sheared off, causing relay to be inoperative. Threaded end was drilled out of insulated frame, care being taken not to ruin insulated threads. A hole was then drilled in armature with #29 drill and tapped with 8-32 tap. A brass screw secured to this and insulated frame, brass being less brittle than original armature metal, with less chance to breakage. After tests, equipment operated normally.

Those field activities having access to a supply of the obsolete model GP aircraft radio transmitters may use the GP keying relay interchangeably with that for the TBW as the units are identical.

EXTENSION OF THE FREQUENCY RANGE OF TBX SERIES EQUIPMENTS

The modification described here will increase the rated high-frequency limit of the TBX by 1475 kc. The TBX will operate at a frequency 475 kc. higher than its rated frequency without modification and another 1000 kc. can be added with the modification to follow. This modification is covered by specification RE 9361A which specifies an additional 800 kc. and which in practice is exceeded by 200 kc. making a 1000-kc. extension of the frequency band.

A modification kit, consisting essentially of new coils, has been obtained and distributed under contracts NXsr 56828 and NXsr 48311. If the kit has not been obtained, the coils may, as a temporary measure, be modified as follows:

(1) The materials required are a two-foot length of #14 tinned copper wire, 1 strip of thin copper approx. $3/16'' \times 2 \frac{1}{2}'' \times 1/64''$, and 1 sheet of mica or varnished glass tape approx. $3/8'' \times 2 \frac{1}{2}'' \times 1/64''$.

(2) The following steps are illustrated in Figures 1, 2, 3, and 4.

(3) Remove r-f ammeter M-301 to permit access to the necessary connections.

(4) Remove jumper wire between capacitors C-308 and C-312, lugs 1 and 2. In TBX-4 only remove end of resistor R-321 from capacitor C-312 lug 1 and reconnect to capacitor C-308 lug 2.

(5) Remove wire from variable condenser C-307 lug connecting to lug 1 of capacitor C-312.

(6) Run a bus bar wire lead as short as possible from variable condenser C-307 lug 6 to capacitor C-313 lug 8.

(7) Run a bus bar wire lead direct from capacitor C-312 lug 1 to the left hand terminal of the r-f ammeter, viewed from the front panel.

(8) Remove the jumper between capacitor C-312 lug 4 and variable condenser C-307 lug 5 (attached to condenser C-307 frame).

(9) Run a new lead from capacitor C-312 lead 4 to the lead point 7 on switch S-304 and capacitor C-313 lug 8.

(10) Be sure that all leads are properly crimped and make secure mechanical connections before soldering.

(11) Connect r-f ammeter back into circuit.

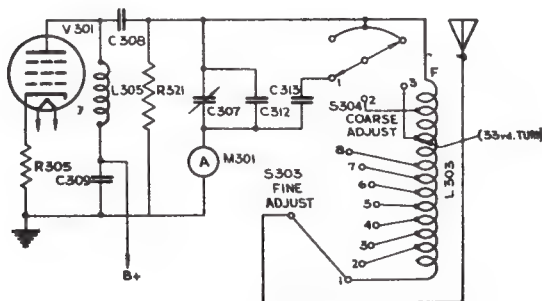


FIGURE 1.--Original output circuit

(12) Locate the m-o inductance L-301 and note carefully the three coil taps. The tap on the 11th turn should be moved 4 turns toward the center of the coil and placed on the 15th turn. The tap on the 39th turn should be moved 3 turns toward the center of the coil and placed on the 36th turn. These changes should be made by slipping the wires out of the existing taps and making new taps from the copper cut into strips approx. $3/16'' \times 7/16''$ and slipped under the correct turns after they have had the enamel removed by scraping with a knife. A strip of mica or glass tape approx. $3/8'' \times 1/2''$ should be slipped under the copper strip next to the coil form to insulate new tap from adjacent turns.

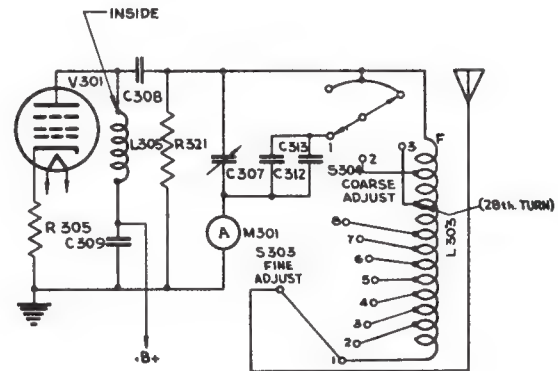


FIGURE 2.--Revised output circuit

(13) Locate the antenna tuning inductance L-303. When viewing the chassis facing the front panel, the tap on the 33rd turn should be moved five turns to the left, placing it on the 28th turn. This tap is the second from the right end of the coil. This change in tap location should be made as were the changes in L-301 as explained above in step (12).

(14) Recalibrate the transmitter. This may be done with a frequency standard such as the LD or LM. The transmitter is tuned to zero-beat with the frequency meter at the desired frequency and the dial readings recorded. Where a frequency standard is not available, the receiver calibration may be utilized to calibrate the transmitter. The receiver is tuned to the desired frequency using the receiver calibration chart. With the "netting switch" on and both power supplies in operation, the transmitter is tuned to zero-beat in the phones. The transmitter dial readings are then recorded. Improved accuracy can be obtained if a station of known frequency is located near the desired frequency. The receiver calibration can be corrected by means of the "wobbler" control, and this control left in that position when zero-beating the transmitter to the receiver. If such a station is not available, the "wobbler" control should be set at zero. It will be noted that band one of the transmitter can be plotted to the same chart scale as before, but band two will have to be plotted to a smaller scale (one-half) due to increased frequency coverage.

(14) The leads to transmitter plate choke L-305 are to be reversed. The plate lead of oscillator tube V-301 should be connected to the inside or start of choke winding and the outside of finish choke winding should be connected to the plate supply.

MODIFICATION OF TBX-2 PORTABLE RADIO EQUIPMENTS HAVING SERIAL NUMBERS 509 TO 800, INCLUSIVE

In some of the type CG-43005 transmitter-receiver units of the TBX-2 portable radio equipments, capacitors C-313 and C-314 were inadvertently transposed during manufacture. Under certain conditions of operation (if operated below 2200 kc. on ANT. COARSE adjustment on top no. 1), the performance of the unit will be impaired due to this transposition. All units bearing serial numbers from 509 to 800 inclusive should therefore be examined, and, if the error is found to exist, it should be corrected in accordance with the following instructions:

Locate and examine the fixed mica capacitor C-313, mounted on the top side of the transmitter chassis immediately below the SEND-RECEIVE switch. When located, note the part number that is stamped on the edge of the capacitor nearest the panel. If this number is 7761328-27, these instructions should be disregarded since this is C-313. If the number is 7761328-16, however, C-314 has been used in place of C-313, and the two capacitors must be interchanged. C-314 is mounted on the same posts as C-313, but is on the underside of the transmitter chassis.

Carefully remove all wiring to the lower capacitor by heating with a soldering iron and at the same time using a small screw driver to pry open the loop in the end of the wire. On the capacitor mounted above the chassis, the wire leading from the lug nearest the p-a tuning capacitor should be unsoldered at the variable capacitor and ammeter junction, the other lead at the SEND-RECEIVE switch.

Remove the no. 6-32 hex nuts, 1 1/8" bolts, aluminum spacers and finally the capacitor. The upper capacitor may be removed by slightly bending the wire removed from p-a ammeter junction, sliding it toward edge of set in back of panel bracket.

Check the rating of 7761328-27 as 0.00008 mfd. and that of 7761328-16 as 0.01 mfd.

Remount the capacitors. Be sure that the shorter wire of C-313 is connected to lefthand lug facing nameplate side (this assures maximum clearance between lugs and shield) and that the red color-coded wires at C-314 are not short-circuited to ground.

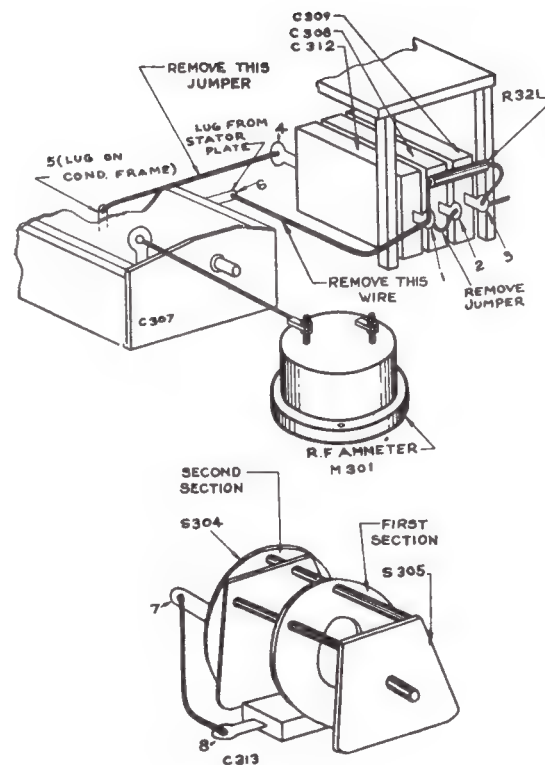


FIGURE 3.--Original connections.

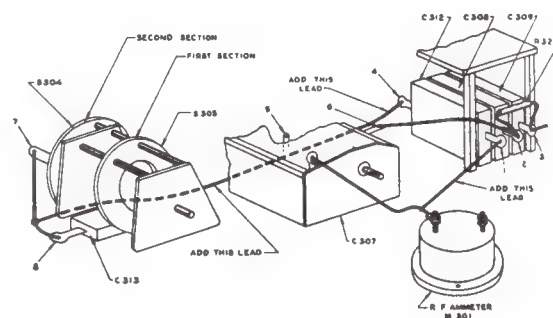


FIGURE 4.--Revised connections.

REVISION OF TCC-3 EQUIPMENT FOR PARALLEL HIGH SPEED KEYING

The high speed keying circuit of Figure 1 is not intended for general use and should be used only in those instances where high speed keying or parallel high speed keying of TCC transmitters is necessary. No standard Navy type units which will provide similar operation are available at this time.

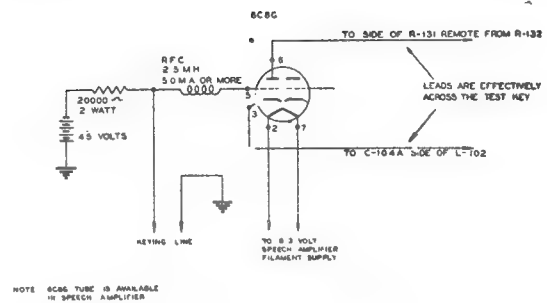


FIGURE 1.--Revision for TCC-3 equipments

MECHANICAL ALIGNMENT OF TURNING MECHANISM

The instruction book for the models TCK and TCK-1 radio transmitters, General Electric publication GEI-16645, advises on page 29, paragraph 3, that instructions for the mechanical alignment of the tuning mechanism may be secured from the contractor upon request.

The Bureau has secured this information from the contractor and it is reproduced herewith for the assistance of naval radio activities in adjusting the tuning mechanisms of the TCK series transmitters. This data is supplemental to that included in TCK series instruction books, and is as follows:

Uni-Control Mechanism (T-7661382)**Step 1**

a. Alignment of counters and drums. (Counters are indicators on left side of mechanism and drums are indicators on right side behind glass.)

This can be accomplished by loosening set screws in pinions and rotating on counter shaft until readings are obtained as follows:

First two numbers on counter to read "0" when "00" on drum just stops moving into full view.

For example, reading on band 1 should be 2,000 on counter and 00 on drum. Reading on band 2 should be 3,000 on counter and 00 on drum, etc.

Step 2

a. Adjustment of counters can be accomplished by loosening set screws in bevel gears and rotating on jack shaft until simultaneous readings are obtained on counters as shown below:

Band	Counter reading
1.....	2000
2.....	3000
3.....	4000
4.....	6000
5.....	8000
6.....	12000

NOTE.--Drums have already been adjusted and should read "00" on above positions.

The drum is spun onto the pinion and pinion fastened to counter shaft by set screws. Therefore, it is possible to get perfect alignment between counters and drums.

The bevel gears (large gears) are fastened to jack shaft (vertical shaft) by set screws and it is possible to get perfect alignment between the counters for each band.

After final adjustment, set screws should be staked with GE Glyptol No. 1276 to prevent screws from loosening. This can be accomplished by removing one set screw from a gear at a time, coating with Glyptol and tightening in place, then remove other set screw and repeat process. In this manner, adjustments will not be affected.

Gears should be set for minimum backlash, but not tight enough to cause binding.

Step 3

a. Adjustment of stop. This is triangular piece that slides on three spacers in back of gear housing. This should be set so counter on band 2 reads 4475 when stop just begins to make contact with rubber stops nearest gear housing. To adjust stop, it is necessary to remove triangular plate on end of slides. To do this, remove 3 nuts on end of slide rods and remove plate. The stop is then threaded onto the screw that drives it and set as above. Replace plate and stake nuts.

It will be necessary to remove Uni-Control from transmitter to make above adjustments. To do this, remove mounting screws and loosen coupling to drive shaft. (For alignment with capacitors see below.)

Step 4--Capacitors

a. Alignment of C-110 and C-124. C-124 and C-110 are variables mounted vertically in set. C-110 at bottom.

Loosen set screws in coupling between C-110 and C-124, so above capacitors can be rotated independently of each other. Then with spacer attached to each capacitor (be sure to use the correct spacer for each capacitor--check serial numbers) rotate to minimum capacity until spacer fits between rotor and stator. It will be easier to set C-110 first by rotating drive shaft, then C-124. Tighten set screws in coupling and stake as per above.

b. Alignment of C-102 with C-124 and C-110. C-102 is MO unit variable.

With C-124 and C-110 in minimum positions as previously determined by spacers, set C-102 at minimum with its spacer so rotor and stator just touch spacer at same time. Fasten set screws in coupling. Stake.

At this point, all three capacitors, C-102, C-110, and C-124 should be in minimum capacity positions as determined by each capacitor gage and all couplings tight so drive shaft turns all three at same time.

Step 5--Uni-Control With C-102, C-124 and C-110

a. Set Uni-Control so band 1 reads 3072.73 kc. and lock control. Then by rotating worm shaft until C-110 is minimum capacity (with gage in position), tighten set screws on fixed hub of Uni-Control.

b. Check adjustment by rotating dial and return to 3072.73 kc. The spacer should just touch rotor and stator plates. If not, compensate by setting set screws. Stake.

NOTE.--When Uni-Control reads 3072.73 kc. on band 1, C-102, C-110, C-124, should be at minimum capacity (plates all the way out).

Step 6--Controls (Transmitter)

a. Antenna capacitor C-126 (top left dial on transmitter). Set dial to read "0" when capacitor plates are fully meshed.

b. Antenna inductance L-126 (Second dial from top left of transmitter). Set dial to read "0" when contact wheel is against stop at rear of coil.

c. Antenna coupling coils (top middle transmitter). Set dial to read "0" when coils are in minimum coupling position. That is, top of inner coils to be extended up to a distance of 1" from top horizontal plate of coil assembly.

d. PA and IPA trimmer capacitors C-125 and C-117 (knob top right transmitter for C-125 and knob middle Uni-Control for C-117). Set knob to point toward "Max" on name plate when capacitor plates are fully meshed.

BLOWER MOTOR IN TCK SERIES

Analysis of failures in the blower motor (symbol B-101) used in Radio Transmitting Equipment TCK Series indicates lack of maintenance. Under normal conditions this motor requires a check every six months; but under severe operating conditions-high temperature, etc.--more frequent checks are necessary.

The following instructions are a guide for personnel assigned to maintain the equipment:

- (1) Remove left side and rear panels of the transmitter.
- (2) Remove rear cover of the master oscillator unit.
- (3) Remove the two grill heaters from their standoff insulators.
- (4) Pull the heaters out of the unit, leaving the leads attached.
- (5) Use a number 8 allen wrench to loosen the set screws holding the fan on the motor shaft, and remove the fan.
- (6) Remove the motor leads from the terminal block.
- (7) Remove the motor mounting capscrews and withdraw the motor.
- (8) Remove the two bolts extending through the motor and pull the end bells. Normally, the bearings will remain on the armature shaft.
- (9) Pull the bearings off the shaft, by hand if possible, and wash them in clean naphtha. Dry thoroughly (by forced air if possible). Test for worn or rough bearings.
- (10) Replace the bearings if they are worn or rough.
- (11) Pack the bearings 2/3 full of Navy Specification 14L3 grease and reassemble the motor. Make sure that the grease shield on each bearing faces to the outside of the motor.

These instructions deviate from those in the instruction book, NAVSHIPS 900,210.

MAINTENANCE OF THE FILAMENT RHEOSTAT USED IN THE TCK TRANSMITTER

It has been reported that the contact arm surface of the filament rheostat in the TCK series transmitter becomes burned and roughened in service. The cause has been traced down, and the difficulty has been found to arise when the pressure of the contact arm against the windings is too light. This pressure, which is provided in part by a coiled spring, will vary according to the amount of use and maintenance. Adjusting the spring and properly shaping the contact arm will set the pressure to the correct value, so that the arm rides firmly on the surface, and yet is not tight enough to bind. These rheostats were designed to have a long life, and with proper maintenance and care should give trouble-free operation over long periods of

time. It is recommended that they be inspected at periodic intervals and corrective action be taken when necessary.

MAINTENANCE OF THE RESET CAPACITOR C-103 USED IN THE TCK SERIES TRANSMITTERS

Several of the reset capacitors used in the TCK series transmitters have been reported to have become "frozen" tight. The clearance between the shaft and bearing of this capacitor is very small, and the unequal expansion of the shaft and bearing, resulting from the temperature of the master-oscillator compartment in which the unit is located, may produce jamming. This difficulty is not too serious, and is easily corrected by polishing the bearing surface with crocus cloth. Periodic inspection and maintenance in conjunction with the regular maintenance schedule is advised.

INTERCONNECTION OF TCK SERIES TRANSMITTERS WITH STANDARD RADIOPHONE UNIT

TCK series transmitting equipment has recently been added to the radio allowance of certain Naval vessels. It is noted, however, that the instruction books for current models of this equipment do not indicate clearly the wiring necessary to incorporate the installation of the present "6-wire" system. This information will be included in the instruction books furnished with subsequent models. Meanwhile the wiring shown in figure 1 should be followed for current installations.

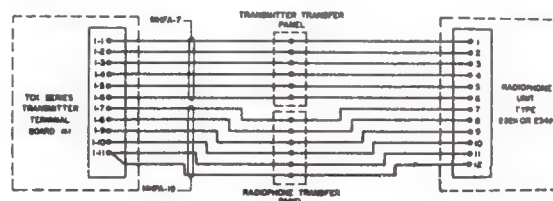


FIGURE 1. Wiring necessary for interconnection of model TCK series transmitters with standard radio-telephone unit

BEARING PULLER FOR TCK MOTOR-GENERATOR

It has been reported to the Bureau of Ships that difficulty has been experienced with the bearing puller supplied with the motor-generators of certain TCK series equipment. One such report stated that a reasonable amount of pressure on the puller failed to force the bearings from the shaft. The unit in this case had to be taken to the shop for removal of the bearings.

All activities and vessels having TCK series transmitters with motor-generators aboard are requested to report all deficiencies of the bearing puller and any difficulties experienced to the Bureau of Ships.

MOUNTING OF VOLTAGE REGULATOR FOR MODEL TCK-4 RADIO EQUIPMENT

Considerable difficulty has been experienced with the mounting of the voltage regulator, symbol VR 301, in the model TCK-4 transmitting equipment.

This unit is mounted on four metal cylindrical pillars tapped at both ends and is located in the top section of the rectifier unit type CG-20219. Vibration which occurs both in transit from the manufacturer and in the shipboard installations sometimes causes the mounting screws to "back out" and leave the voltage regulator free. This invariably allows the unit to drop to the shelf below where it causes considerable damage.

To prevent this situation it is recommended that the metal pillars have holes drilled through them and a 1/4-inch bolt be used to mount the voltage regulator. It is further recommended that a lockwasher and two nuts, the second nut to be a locknut, be used.

No further procurement of TCK-4 is contemplated at this time. However, it is recommended that all activities confronted with this problem proceed to correct it in the manner described above or in any other practicable way which will prevent the voltage regulator from falling out of position.

TRANSFORMER CONNECTIONS IN POWER SUPPLY OF TCK-4 AND TCK-6 EQUIPMENT

Faulty operation of a TCK-4 transmitter rectifier power supply utilizing type 836 tubes has been reported. The report also that the difficulty was overcome by using type 866A/866 tubes.

The use of either type 836 or type 866A/866 tubes in the rectifier power supply is permissible providing the transformer connections are proper for the respective types. The connections must be changed if tubes of one type are replaced with tubes of another type. The proper connections for the use of type 836 tubes are shown in figure 7-21, Rectifier Unit Schematic Diagram, of the technical manual, NavShips 900,210. A note on the schematic diagram lists

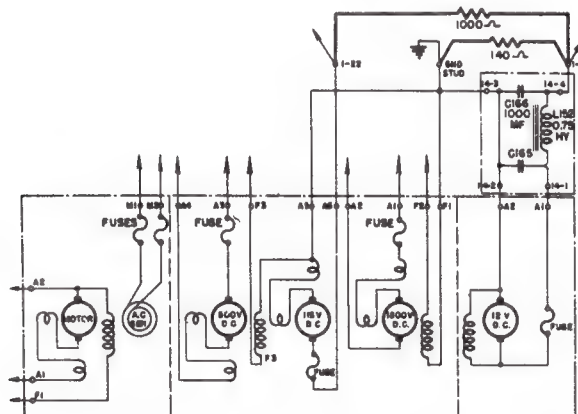


FIGURE 1. Model TCK.

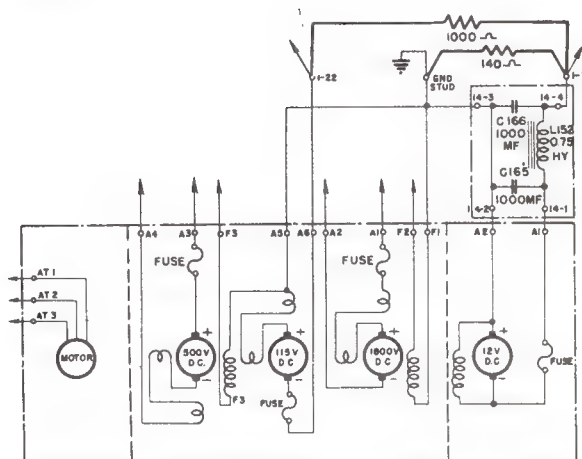


FIGURE 2. Models TCK and TCK-1.

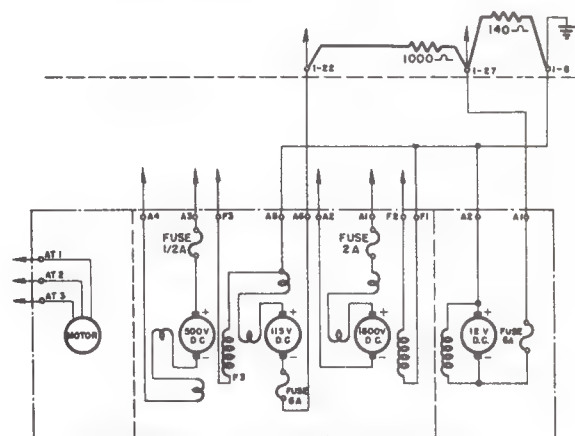


FIGURE 3. Models TCK-2 and TCK-3.

the changes required when operating with type 866A/866 tubes.

EXCITATION TO 12-VOLT MOTOR GENERATOR

Difficulty has been experienced with the motor generator of the TCK in that it is sometimes necessary to momentarily excite the field from an external source to start the 12-volt unit generating to supply voltage to the microphone and the carrier control relay.

A modification to the TCK Series equipment which eliminates the necessity for using the external voltage has been proposed.

This modification consists of exciting the field of the 12-volt motor generator from the output of the 115-volt D-C bias generator. This may be accomplished by permanently connecting, in a suitable manner on the TB-1 in the base of the transmitter, one 1000-ohm 30-watt resistor JAN STYLE RW 34G 1000 (MIL-R-26B) and one 140-ohm 2-watt resistor JAN STYLE RC 42GF 141J (MIL-R-11A) as shown on figures 1 through 4.

TCK SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Spurious ground when using 4-wire control on ships having d-c supply.

The 12-volt motor-generator units for TCK series equipments fail to build up—as shown by little or no plate current meter reading when the microphone press-to-talk switch is closed.

When one-half power was applied, overload relay K-103 would kick out and line fuses would fail.

Cause and Remedy

Each time the press-to-talk relay is closed, a ground is placed on one side of the ship's line. This is caused by one contact on K-151, drawing T-766 1426, being grounded. The trouble can be readily overcome by removing this ground connection and running a new lead from this contact to link terminal "D" on terminal board #8.

The following test procedure should be followed:

- (1) Operate test key. If transmitter operates, then check 12-volt generator voltage.
- (2) If no voltage is apparent in the generator, remove the generator brushes and examine for dust and film. Clean with fine sandpaper. Caution: Do not use emery cloth on the brushes.
- (3) Check commutator surface for dirt and film. Clean with soft, dry cloth.

NOTE: This is only a temporary expedient.

See TCK Field Change No. 1.

Rectifier filament transformer T-303 had developed an internal short between primary and secondary windings. Replaced the transformer and operation became normal.

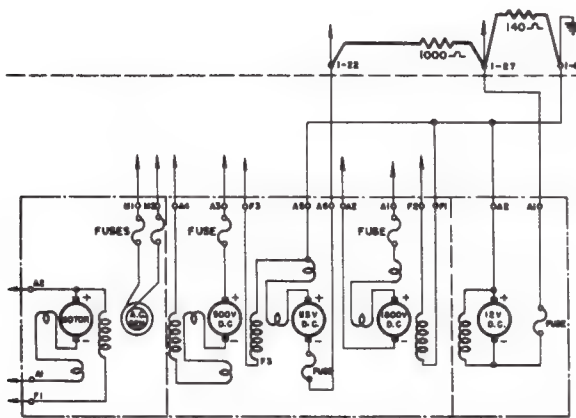


FIGURE 4. Models TCK-3 and TCK-5.

TCO SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Receiver dead, no plate voltage on 6SK7 r-f amplifier.

Found primary winding of r-f transformer T-105 open.

Cause and Remedy

Emergency repair was made as follows: A 2.5-millihenry r-f choke was substituted for the primary winding by connecting it from the 6SK7 plate to the junction of R-125 and C-120. A 0.0005-mfd. capacitor was connected between the plate of the 6SK7 and the secondary of T-105 at the junction of C-119 and C-134. The modification necessitated realignment of the mixer stage.

TCP SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

TCP-1.--Primary of r-f transformer burned out.

TCP-1.--Motor-generator for transmitter ran continuously.

The transmitter operated normally when the push-to-talk button was pressed, but the motor-generator failed to stop when the remote telephone was replaced on the hook.

TCP-2.--When the hand telephone set was lifted from the cradle unit CRM-51026 in the remote position, the carrier came on **before** pressure of the push-to-talk button to the telephone unit.

TCP-2.--Transmitter-receiver completely dead. Main fuse blew when transmitter was turned on.

TCP-3.--Could not resonate antenna circuit due to full-scale deflection of antenna ammeter before attainment of resonance.

Cause and Remedy

Investigation showed that this failure was due to r-f pick up from TBK-17; the antennas of both equipments were parallel and close by. A 100-watt incandescent lamp in series with the receiving antenna prevented this from recurring. The r-f transformer primary winding was rewound, reinstalled and the set operated normally after that.

Found that the insulation between the motor start contacts in the remote position was breaking down. Repaired and normal operation restored.

Inspection revealed that the wire stays of the handset cradle on the main unit caused depression of the push-to-talk switch on the main hand set which was not in use. Repaired by bending the cradle so as to relieve pressure on push-to-talk switch on main handset.

The cause of this trouble was a short between the moving contacts of the motor-generator starter and the lead between resistor 86B and the overload relay. A recurrence of this trouble was prevented by drilling a hole through the switch panel and running a new lead between the panel and the asbestos. This eliminated wire from the front panel except for the connections.

Added extra 0.0015 mfd. capacitor as per instruction book.

Could now attain maximum on plate current meter, but antenna ammeter deflected past full scale on modulation. Shunted antenna ammeter with #14 wire; this lowered reading to 3.5 amp. for carrier and 4.5 amp. on modulation.

TCS NON-MAGNETIC CABINETS FOR USE ABOARD MINESWEEPING VESSELS

Long Beach Naval Shipyard in complying with Field Changes 10-TCS-1 through TCS-15 entitled SUBSTITUTION OF NON-MAGNETIC-ALUMINUM CABINET IN PLACE OF STEEL CABINET, discovered that some original cabinets being replaced were made of non-magnetic chrome-nickel stainless steel. These stainless steel cabinets were found to have a magnetic permeability of less than 1.2 when measured on a permeability indicator.

In view of the above and in the interest of economy, activities should accomplish this field change only on original equipment cabinets found to be magnetic by actual test when these equipments are to be installed on wooden or non-magnetic mine-sweeping vessels.

TCS EMERGENCY OPERATION

The batteries used with the TCS equipment aboard ship are primarily intended as an emergency supply of power in case of ac power failure. They should be maintained fully charged at all times. In cases where the TCS equipment is not used for long periods of time, it is recommended that the batteries be placed on trickle charge at regular intervals. Normally, this may be accomplished by turning on the Power Supply PP-388/U for one hour each day. Longer periods of charging should be used if necessary.

SUBSTITUTE GENERATOR

In the interest of economy, FSN N6115-248-0398 (NT-211219B) Generator will not be procured. In lieu of this, stock on hand under FSN N6115-248-1905 (NT-211219A) will be utilized for use with TCS series equipment. This is an acceptable substitute. Activities that receive this substitute generator should obtain the repair parts listed in SNITs, Navy Type 21826, symbols C-1607, C-1612, G-1602A, B, C, H, M, P, V and W.

MX-1743/SRC INSTALLATION OF TCS CONTROL ADAPTER

The MX-1743/SRC control adapter used for adapting the TCS series radio-receiving and transmitting equipment to the conventional-shipboard, remote-control system presents some difficulty in making the proper connections to the TCS equipment. This adapter is a replacement for the type 23524 adapter which has a built-in plug receptacle to accommodate the cable plug on TCS cable No. 65F-10 originally connected to the TCS remote type 23270. The MX-1743/SRC contains terminal strip, TB-602, which necessitates the removal of the plug from cable No. 65F-10 before the conductors can be connected.

The INSTALLATION INSTRUCTIONS AND LIST OF PARTS, which accompanies the MX-1743/SRC adapter, includes BUSHIPS Drawing No. RMHP-23-D-127 (Rev. A). However, this drawing does not indicate the cross connections from terminals 20 through 28 on TB-602 to the TCS cable and a considerable amount of time may be lost in tracing out the TCS circuits.

Figure 1 indicates the cross connections from TB-602 to the conductors of the TCS cable No. 65F-10.

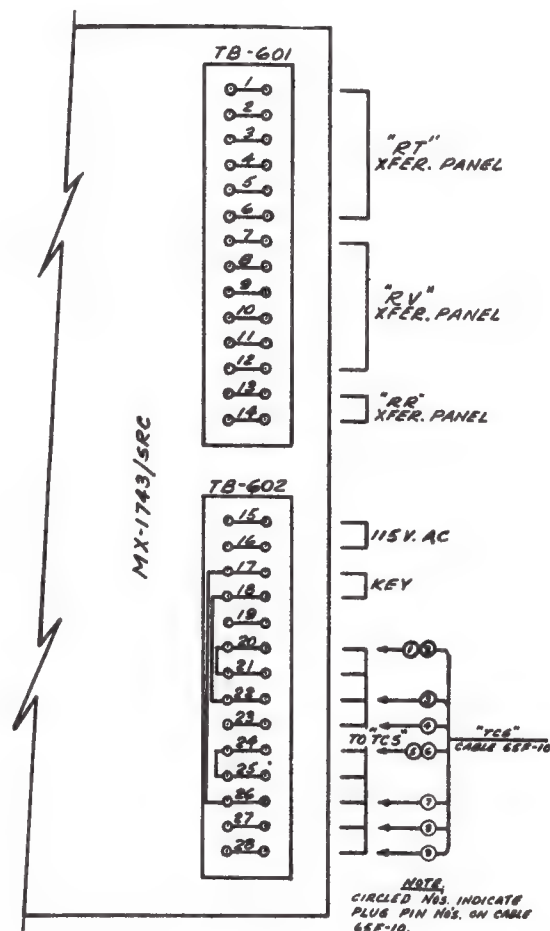


Figure 1

ADAPTER UNITS FOR TCS SERIES RADIO RECEIVING AND TRANSMITTING EQUIPMENT

An adapter unit is required whenever the TCS series equipments are to be interconnected into the standard Navy six-wire radio remote-control system.

On all future shipboard installations of the TCS equipments where an adapter unit is necessary, the installing activity will be required to manufacture this unit. Bureau drawings RE 65AA 255 and RE 65F 254 provide the necessary

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

information for the construction of a standard unit. Full-size copies of these drawings may be obtained by application to the Bureau, Code 991.

The following controls and indicating devices should be mounted on the front panel, with designations marked appropriately on the panel:

Symbol	Name	Panel Marking
S-601	Adapter on-off switch.	Adapter and TCS Rcvr. (on-off).
S-602	Transmitter start-stop switch.	TCS Xmtr. (start-stop)
S-603	Remote-local switch.	Remote (on-off).
S-604	Telegraph key circuit switch.	Key (on-off).
I-601	Adapter on indicator.	Adapter and TCS Rcvr.
I-602	Transmitter motor-generator on indicator.	TCS Xmtr.
I-603	Transmitter carrier on indicator.	Carrier.
R-603	Earphone level control.	Earphone level.
J-601	Handset jack	Handset.

The plug (P-601) should be located on the left side of the unit and be marked to TCS.

The following parts are used in the construction of the adapter unit:

Symbol Designation	Rating and Description
S-601	Toggle switch capable of controlling 500 w at 250 v a-c/d-c.
S-602	Push-button normally-open switch (two push-buttons) capable of controlling one ampere instantaneous (0.5 ampere steady-state) of 250 v a-c (inductive circuit).
S-603	Remote-local switch (toggle or rotary); all contacts to be capable of controlling 1/2 ampere at 250 v a-c or d-c and carrying momentary currents of 1 ampere at 250 v a-c or d-c.
I-601	115/125 v candelabra screw-base indicator lamp to be viewed through red lens. Not more than 10 watts.
I-602	115/125 v candelabra screw base indicator lamp to be viewed through amber lens. Not more than 10 watts.
I-603	Western Electric 2F, 12 v, indicator lamp or equivalent. To be viewed through green lens.
T-601	Transformer: microphone/line, line/line. Microphone primary: impedance of 35 ohms, to be capable of carrying 100 ma d.c. Line primary impedance 600 ohms. Secondary impedance 75 ohms. Audio response to vary less than 1 db from the 1000-cycle level over the 100- to 3500-

K-601	Relay to operate on any d-c voltage between 8.5 and 15 volts; current required not to exceed 75 ma at 12 volts.
K-601A	Contacts to be capable of handling 0.5 ampere at 15 volts d-c.
K-601B	Contacts to be capable of handling 0.5 ampere at 15 volts d-c.
K-602	Relay to operate on any 60-cycle, a-c voltage between 35 and 65 volts; current required shall be 0.25 ampere $\pm$ 10 percent at 55 volts.
K-602A	Contacts to be capable of handling 0.75 ampere at 15 volts d-c.
K-602B	Contacts to be capable of handling 0.5 ampere at 125 volts a-c.
K-602C	Contacts to be capable of handling 0.5 ampere (steady-state) and 1 ampere peak at 125 volts a-c.
P-601	Plug connector, 10-ampere, 9-conductor wall mounting, Cannon Electric Development Co., type GK-9-32S or equivalent.
J-601	Jack, Ampnenol, type AN-3102-14S-5S or equivalent, coded green.
PS-601	Power supply to convert 115-volt, 60-cycle, single-phase a.c. to a nominal 12 volts d.c., and shall include all necessary components for this purpose. Power supply shall not require more than 40 watts from the 110-volt source and shall furnish a nominal 12-volt d.c. with not more than 0.5% ripple-voltage at a continuous load of 735 ma., without damage or overheating. Temporary infrequent intervals of 1.3 amperes shall not cause damage. The output voltage shall remain within the limits of 9.5 to 15 volts under any load from no load to full load, and under any variation in line voltage up to $\pm$ 5%.
R-601	Resistor, 120 ohms $\pm$ 10%, 2 watts.
R-602	Resistor, 400 ohms $\pm$ 10%, 30 watts.
R-603	Attenuator, constant input-impedance of 600 ohms, 1 watt, approximately uniform attenuation per degree rotation, 40 db attenuation range.
C-601	Capacitor, electrolytic, 100 mfd, 25 w.v.
C-602	Capacitor, paper, 4 mfd $\pm$ 10%, 400 w.v.
F-601	Fuse, 3 amp., 250 v., a.c.
F-602	Fuse, 3 amp., 250 v., a.c.

The adapter unit should be adequately shielded and care should be exercised to preclude the introduction of noise

or other undesired voltages in the microphone and audio output circuits.

TEMPORARY MODIFICATION OF TCS CRYSTAL CIRCUIT

The following suggestion is published for possible use in the event that similar difficulties are encountered by other activities. **The modification should be made only in cases where trouble of this nature has been encountered.**

In some instances certain crystals in the TCS transmitter oscillator circuit operate sluggishly or fail to oscillate entirely. These same crystals when placed in another transmitter operate satisfactorily. This condition indicates that the fault was in the transmitter and not the crystal. The crystal oscillator circuit in the TCS transmitter was improved by replacing the one-millihenry choke (L-109) with a 2.5-millihenry choke. After this modification no further difficulty was experienced.

ANTENNA LEAD MODIFICATION

TCS radio equipments are installed in some vessels with the transmitter section, type-52245 mounted on top and directly above the receiver section, type-46159 with the complete equipment located three feet in front of a radio operator's position. This arrangement results in numerous breaks and disarrangements of the antenna lead from transmitter to receiver due to operators accidentally catching the lead with clothing, back of operator's chair, and patch cord leads. Various types of braided, twisted, and solid wire have been tried but did not eliminate the trouble.

A coaxial lead alteration was designed and installed on one pilot TCS equipment. No further failures have occurred due to its additional strength above the previous hook-up method.

To install this alteration remove the antenna posts on both the transmitter and receiver, slightly enlarge the face-plate hole with a round file, and install a coaxial adapter, type-49194. Connect the units with a short length of RG-8/U cable using two connectors, type-49192 and one adapter type-49195 on each end, to achieve a double 90 degree bend so as to clear the operator's control handles.

MODIFICATION OF TCS POWER SUPPLY PP-380/U

Remote control of the TCS radio equipment when used with the PP-380/U Power Supply is made possible by means of a simple modification of the power supply to permit use with Remote Control N.T. 23270. This modification may be performed by Navy Yard personnel using parts obtained from standard stock. No special tools are necessary. The modification consists of installing one 10 ampere 9 conductor plug connector, wall mounting type with mounting hardware manufactured by Cannon Electrical Development Company. Manufacturer's type GK-9-32S on the chassis of power supply PP-380/U as shown in Figure

1. Using wire similar to N.T. SRIB-3, wire in the new connector as shown in Figure 2. Remove ground leads from switch S-602 and connector P-601 in remote control unit N.T. 23270 and connect S-602 and P-601 as shown in Figure 3. Removing the above leads from ground is necessary since relay alternating current in lieu of 12.6 volts direct current as in previous power units used with the TCS equipments. K-302 in the power supply is actuated by 110 volts.

The modification above is to be on an optional basis and no kits are to be supplied.

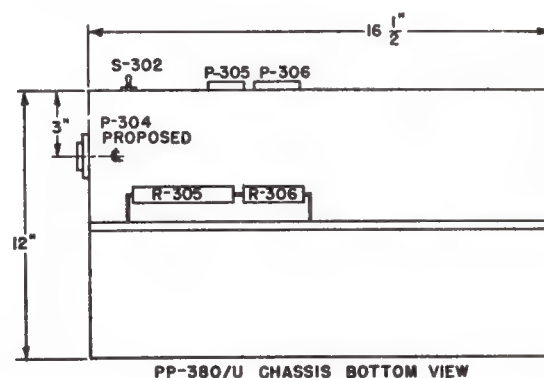


FIGURE 1.

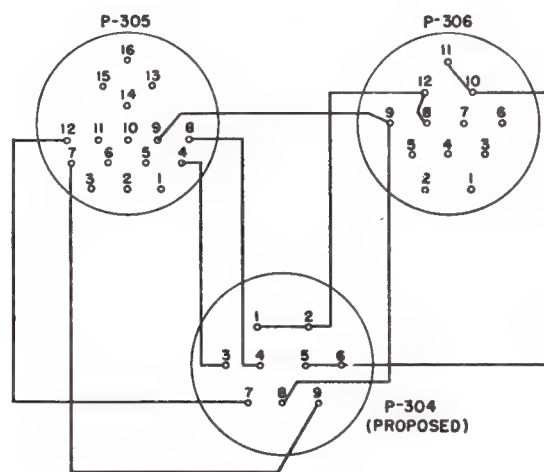


FIGURE 2.

IMPROVEMENT OF TCS RADIO RECEIVING EQUIPMENTS SENSITIVITY

The following suggestions are to improve the sensitivity of the receiver of model TCS:

(1) The receiver input and transmitter output of the TCS unit were designed to operate effectively on a 20-foot vertical whip type antenna.

(2) During Navy yard installation, a single antenna approximately 35 feet long was installed. A type 47205

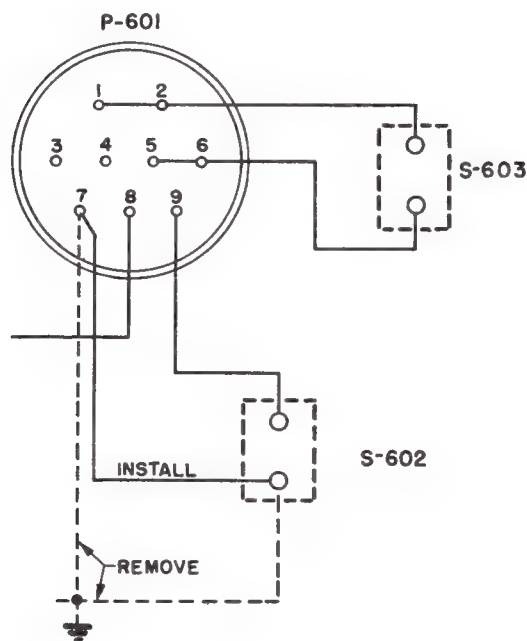


FIGURE 3.

antenna loading inductance was incorporated in the antenna circuit. The type 47205 inductance was varied by means of 6 taps, tap 1 being the maximum inductance and tap 6 the minimum.

(3) In the installation on the U. S. S. **Caldwell** it was found that use of tap 6 resulted in greatly increased sensitivity of the receiver. Other taps either reduced the signals 50 to 75 percent or completely cut them out.

(4) It is suggested that operators of the model TCS determined by trial the optimum setting of the type 47205 inductor based on receiver performance and that if at all possible transmitter tuning should be accomplished with the loading inductor contained in the TCS transmitter.

TCS SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Leads inside antenna loading coil arc over.

Excessive noise in 24-volt d-c TCS receivers installed in PT boats.

IMPROVING THE EFFECT OF THE TCS INTERLOCK

The TCS equipment is equipped with an interlock that is not entirely effective from a safety standpoint. At present, opening the interlock only removes power from the equipment if the TCS remote switch is in the OFF position.

It has been suggested a modification of the TCS transmitter to improve the effectiveness of the interlock, the details of which are as follows:

- Remove the jumper between pins 12 and 15 of transmitter plug P101 on the TCS power supply.
- Remove the wire from pin 12 on transmitter plug P101 and connect it to pin 15.
- Remove the wire from pin 7 on transmitter plug P101. This wire is also connected to the remote plug which is also on the power supply.
- Connect the wire removed from pin 7 to pin 12.
- Connect a wire from pin 12 of P101 to the side of switch S107 that is connected to interlock S106.

These wiring changes place the interlock switch in series with both power ON-OFF switches so that the power will be removed from the equipment whenever the interlock is open.

FAILURE OF GAIN CONTROLS IN TCS SERIES EQUIPMENTS

The Bureau has received a large number of failure reports, reporting failure of the r-f and audio gain controls in TCS equipments. These controls are symbols R-216 and R-220.

In most cases failure is due to operating personnel rotating the controls excessively or twisting them beyond the normal limits of travel.

All maintenance activities are urged to impress upon operating personnel that these controls can be turned just so far and **no more**.

Cause and Remedy

This is due to insufficient insulation and spacing between these leads to take care of the high r-f voltage built up across the loading coil when used with short antennas on certain frequencies. If the internal leads are of size #14 or larger, the remedy is to bend the two leads so that there is considerable clearance between them. The stiffness of the wire will tend to maintain this clearance.

This noise is caused by the motor units in the power supply. It may be cured by bypassing the 24-volt line at the motor with a 0.5- to 1.0-mfd. 200-volt metal clad condenser.

TCS SERIES TROUBLE SHOOTING NOTES -- Continued

Difficulty Encountered

No modulation.
No plate current. Generators running.

Hum on carrier when using voice.
Fuse F-502 blowing constantly.
Fuse F-501 blowing constantly.
No dip of plate current.

Low antenna current.

Relay trouble.

Main radio fuse failure.

Receiver squeals or chirps over entire band.

Could not "raise" anyone with transmitter although tuning was normal and antenna current was 3 amperes. Receiver operation was normal.

TCS-9.-- Both transmitter and receiver dead; rectifier tubes in a-c power pack lit.

Receiver dead. Transmitter generator does not start. No output voltage from receiver high-voltage generator. Finally, receiver generator runs "hot."

TCS-5.-- Receiver dead. No plate voltage.

TCS-8.-- Receiver operated properly until transmitter was turned on; then both would go dead.

Cause and Remedy

It has been found necessary in a few cases to bypass each brush to the motor frame with a 0.005-mfd. mica condenser. This must be mounted at each brush. In one unit the brushes were found to be reversed in their holders. Much less interference was produced when, considering the direction of commutator rotation, the soft carbon, nonmetallic half of the brush formed the trailing edge.

Relay K-101 not making contact in voice position
Lead from power supply broken at K-502 in motor-generator unit.

Bad tube, V-106 or V-107 in push-pull modulator.
Shorted condenser, C-501, C-504, C-506 or C-515.
Shorted condenser, C-510, C-511, C-512 or C-516.
Check oscillator tube V-102 and its selector switch and crystal.

Insulator at base of antenna shorting to wet deck at times.
Keep antenna free of wet cloths, etc.
Frequent check of dirty contacts and proper spring tension is well worth your time.

After radar and fluxgate compass were installed we found that the 30-ampere fuse for radio in distribution panel in engine room required a 60-ampere fuse.

Faulty receiver oscillator tube V-203, or poor contacts on receiver gang switch.

Ohmmeter reading from the antenna to ground showed a low resistance between these two points. Found antenna insulators were covered with paint. Cleaned off the paint and, as a good measure, put in new power-amplifier tubes. Opened up the antenna trunk and found a piece of steel, dimensions 1/4" x 5", which had fallen inside the trunk. Also found bits of welders' "slag" and bits of metal caused by a Navy yard "burner." This shorted out antenna when any amount of RF was on it, but allowed signals to pass to the receiver. When the piece of steel was removed and the bits of slag and metal, the sets worked normally.

Found no power being supplied to transmitter--checked control relay K-301. Found defective insulation under relay, cracked and broken, with pieces lodged against relay contact arms causing sticking. Replaced. C-512 brush hash filter capacitor shorted. Replaced capacitor and set operated normally.

A short circuit developed in the transmitter power cable which caused a very heavy current to flow through the reactor. As the reactor L-503 overheated, the pitch filling forced its way out of the can, allowing the choke to short out partially to ground. Replaced reactor from spares after removing short circuit. Set then operated normally.

Found bad connection at battery connection to TCS. The joint allowed the 4.5 amp. receiver current to pass, but opened when the 9.5 amp. current for the transmitter was added.

TCS SERIES TROUBLE SHOOTING NOTES--Continued**Difficulty Encountered**

TCS-12.--Receiver faded out at 3- to 4- minute intervals.

TCS- 12.--C-225 was found to be shorted.

TCS-6.--Transmitter would not modulate.

TCS- 12.--No 12-volt output and consequently no field excitation or 240-volt output from generator. Measured output from 12-volt winding was 1 volt.

TCS-13.--Output of transmitter considerably reduced.

Impossible to load transmitter (Model TCS- 12).

R202 in receiver heats or is burned out. The transmitter would load normally, but as soon as you spoke into the microphone, antenna current would drop to zero. By retuning the plate capacitor, conditions would return to normal. Since the symptom would not appear in "CW" position of S-105, even when the transmitter was keyed, the trouble was thought to be in the modulator section, and replacement of the modulator tubes, V-106, and V-107 appeared to bear out this contention as the trouble did not immediately reappear. However, a short time later, the trouble did reappear. This time the receiver also began to operate intermittently, as if the antenna were being grounded out.

Receiver noise level normal--no signal.

Receiver inoperative.

Cause and Remedy

Found that the power output from the generator dropped during fadeout periods, the 240 volts dropping to 90 volts and the 12 1/2 volts dropping to 4 volts. Found to be due to defective field coils in motor-generator.

Was probably caused by a very strong signal picked up from a nearby transmitting antenna.

Found to be due to a modulator power relay K-101 not making contact, causing lack of plate voltage on modulator. Repaired by readjustment of relay.

Commutator was slightly carbonized. Cleaned commutator and brushes but still no output. Flashed field with 12 volts and output was normal for about two minutes then dropped off again. Noticed considerable sparking at 12-volt brushes. Heavily applied brush seating stone and normal operation resumed. Checked commutator and found it 0.001" off. Turned down commutator-reapplied seating stone and all okay.

Meter M-102 burned out. Placed a jumper across meter to effect an emergency repair.

Editor's Note: **Meter should be replaced at first opportunity.**

Antenna loading-knob was difficult to turn. Short lead from shaft holding movable contact for inductor L-108 had broken. Plate on which lead was connected had come loose and was rotating with the coil. Replaced lead and fixed plate. Equipment operates properly.

Check for a rotor-stator short in C201-B.

Antenna loading coil was checked. All connections were tight on the front of the unit, but removal and inspection revealed that the nuts were loose on the back of both feed through insulators connecting the loading coil to the transmitter and the antenna respectively. The connections were tightened and the trouble remedied.

Check pin No. 2 of P-201 to ground for resistance. Correct resistance is 39,000 ohms. If higher than this figure, wipers on S-202 may not be making good contact. Removal of backplate is most feasible method of access to said switch.

(a) Check rear contacts of K103 in the transmitter. Said contacts control screen voltage on receivers.

(b) Voltage check shows no plate voltage on V206. Z204 may be shorted.

(c) Check operation of local oscillator. Connect V.T.V.M. from control grid to ground. Vary tuning control. If V.T.V.M. reading does not change, check leads on local oscillator section.

(d) Check jack J-201. These have been found grounded out in several instances.

TBS SERIES TROUBLE SHOOTING NOTES--CONTINUED

Difficulty Encountered

Low receiver sensitivity on band No. 1 but fair sensitivity on bands 2 and 3.
Low receiver sensitivity--all bands.

Low receiver sensitivity on any 1 band with other 2 bands normal.
Receiver band 3 inoperative--bands 1 and 2 normal.
Low receiver sensitivity band 3--other bands normal
No AVC action in receiver.

Receiver sensitivity changes suddenly.
Receiver local oscillator inoperative.
Receiver RF amplifier has no gain.
Receiver motorboats in several positions on dial.
Transmitter relays not operating.
Heavy loading and very small resonant dip in IP at frequencies less than 2,000 kc.
Downward modulation in transmitter.
Transmitter M101 reading off scale.
No transmitter grid drive to final.

No modulation in transmitter.

Excessive transmitter plate current.
Low output H.V. supply.

High-voltage condensers not bleeding off.

Fuses blow out.

Relay K301 inoperative.
No high voltage.
Blows fuses on low voltage side.

TCS-12--Low receiver sensitivity on all bands--audio volume control had no effect on signal strength but did effect the noise level.

Cause and Remedy

(e) Check R214 for open circuit.
(f) Check C228 for open circuit.
Check cathode bypass condenser section of S202 for bent wipers or defective contacts.
(a) Check plate voltage on V206. If low, check C230 for high resistance leak.
(b) Check screen voltages on V202 and V205. If low check R215 and R205 for increase over normal value.
(c) Check C225 for change in value.
Look for burned out antenna coil on band which is low.

Check S201 for bent wipers or high resistance contacts.

Check RF padder C225.

(a) Check Sw206.
(b) Check ground connection on r.-f. gain pot.
Check remote control unit.
Check C218.
Check C206.
Check C202.
Check ground on mike jack.
Check for shorted turns on L107.

Look for mismatch in loading network.
Check meter shunt.

(a) Check for dirty or bent contacts on S101.
(b) Check relay K101.

(a) Check C127 for short circuit.
(b) Check C125 for short circuit to ground.
Check C116 for short to ground.

Check for 230-volt connections on primary of power-supply transformer.

Check power-supply bleeder resistors--seems like obvious fault but is quite prevalent.

(a) Mounting screws for power supply relay K301 shorting to ground.

(b) Low-voltage rectifier tubes gassy.

Contacts bent, closed.

Shorted 5R4G tube.

Receiver B + grounded.

Note.-- Check both 6X5 tubes prior to reapplying power.
Replaced VI of field change No. 6, a 12H6 detector and noise limiter. Both sections were suffering from weak emission.

IMPROVING OPERATION OF TCZ TRANSMITTER

The following report covering the operation of TCZ transmitters is published to assist personnel of vessels and activities in improving performance of their equipment.

The Bureau desires that all activities and vessels report operating deficiencies and the remedial measures be taken in order that such may be disseminated to the field for the benefit of all concerned. These reports shall be forwarded to the Bureau.

1--It has been reported that the performance of the equipments installed in radio I and II was poor to unsatisfactory and that the transmitter installed in radio III had not been used because of completely unsatisfactory performance.

2--The following checks were made on the equipment installed in radio I. The transmitter was tuned to 2716 kcs. It appeared to tune normally, except that the settings of dials "C", "D" and "E" did not correspond to the data supplied in the instruction book. An operational check was conducted with poor results. A further check was made at a frequency of 4235 kcs. Again the dial settings did not correspond to instruction book data, although tuning appeared normal. At this frequency, the operation was excellent at the short range check.

3--A wavemeter was obtained to check the transmitter output frequency. It was felt the "PI" network used to tune the final amplifier, while completely satisfactory when properly tuned, might easily be tuned to the second harmonic of the desired output frequency. The transmitter was dialed to the original frequency of 2716 kcs., and the output checked with the wavemeter. This check revealed that there was no output at 2716 kcs., but that the output frequency was 5432 kcs., the second harmonic. Checks made at other frequencies confirmed that the final power amplifier was tuned to twice the desired frequency. Attempts to tune the transmitter using data from the instruction book for the settings of dials "C", "D" and "E" gave harmonic output frequencies in this range.

4--At 4235 kcs. the wavemeter check indicated that the output frequency was correct. This accounts for the satisfactory check previously made on this channel. By variation on controls "C" and "E", it was found that the output frequency could be doubled and normal tuning indications, including good current, would be present.

5--At 215 kcs., the oscillator settings on the low-frequency range were normal. However, after tuning the loading coil, it was found that the transmitter was actually tuned to the second harmonic again, 430 kcs. By further adjustment of the loading coils, the XMTR was set at the desired frequency and very satisfactory communication checks were made. A check indicated that in the 200 to 575 kcs. range the highest frequency that could be doubled by the loading coil tuning was 285 kcs.; above this frequency the range of the loading coil was not sufficient to tune to a second harmonic.

6--Checks conducted in a similar manner on the TCZ installed in radio II indicated that the same conditions existed as were previously found in radio I.

7--Conditions in radio III, insofar as the equipment was concerned, were the same as in the other two spaces. However, satisfactory checks could not be held at 215 kcs. even when the transmitter was properly tuned. Investigation of the antennas revealed the following conditions: In the original installation in radio III, there had been two transmitters and consequently two individual lines. Since only one transmitter, the TCZ, was now in use in this space, one of the lines had been sealed. However, it was found that the trunk line connected to the ship antenna supposedly connected to the TCZ was actually the sealed one, and that the TCZ was connected to a trunk line which did not terminate in the antenna. Correcting this error resulted in operation of this equipment comparable to the other two.

8--It was found that the tuning information for the dials "C", "D", and "E" and for the low-frequency loading coils was not reliable. It is believed that the reason for this unreliability is that the TCZ is designed for aircraft, where the structure surrounding the antenna is similar in all installations and the approximate settings given would be satisfactory. However, in a shipboard installation the capacity reflected into the "PI" network because of trunk lines and superstructure surrounding the antenna permits the network to be tuned to the second and sometimes the third harmonic of the desired frequency. Many times there is no indication at the transmitter that doubling or tripling is occurring. Since this reflected capacitance will vary from ship to ship, it is recommended that a calibration curve for each equipment be taken, using the tuning methods in this bulletin and the instruction book and covering the entire transmitter range. A rough curve was made for the equipments, using the wavemeters previously mentioned.

OPERATION OF TCZ-1 AT EXTREME LOW TEMPERATURES

Field activities contemplating operation of TCZ-1 transmitting equipment at ambient temperatures of minus 30° C. or below are advised to replace the 15-amp. fuse, F-1804, with a similar 20-amp. fuse.

KEYING RELAYS FOR TCZ SERIES RADIO TRANSMITTING EQUIPMENT

Several reports have been received by the Bureau of extremely slow keying speed in the TCZ series equipments. It must be remembered that the rated keying speed of this type transmitter is 30 words per minute. The keying relay employs multiple contacts timed to close in sequence. Improper timing will cause improper operation. It is suggested that all vessels examine and retune these relays if required, possibly with the aid of an oscilloscope.

These relays will operate with a minimum of 18 volts d.c. applied to the coil, but will only follow keying of eight impulses per second with this voltage. With 28 volts d.c. applied, the armature will follow proper keying speeds. The maximum voltage that should be applied to the relay coil is 32 volts d.c.

Instructions for adjustment of the keying relays are included in the appendix in the rear of the equipment instruction books. It is to be noted that the tension of the armature return spring, as measured at the top of the Bakelite strip, should be about 24 ounces. Note also that the contacts should be adjusted so that the gap between the movable contacts and the fixed contacts, when the relay is unoperated, is between 0.015 inch and 0.020 inch. These adjustments may be made using the scales and gauges included in the TE-50A teletype repair kits. If the necessary tools are not readily available, the relays should be replaced, and the defective parts repaired and properly adjusted at the earliest opportunity.

RECOMMENDED TUNING PROCEDURE FOR TCZ EQUIPMENTS

Practice has shown that the 913 tube has critical dynamic characteristics. The problem of building a general

purpose tube for wide application is difficult. Transmitters of various circuit designs employing the 813 respond in different manners. The 813 functions properly in types TDO and TDM, but is extremely critical in the TCZ. The erratic operation is due to the screen grid design. The basic was made to JAN specifications which are evidently too broad in scope. These characteristics result in low off-resonance plate current even though the control grid current is normal, showing sufficient drive.

When tuning the TCZ under loaded conditions little or no dip in plate current is experienced when passing through the resonant point.

When adjusting the final amplifier of the TCZ, make certain the antenna coupling is loosened before attempting to find the resonant dip. After the positive dip is found, tighten the antenna coupling to the point where the plate current will show a slight drop when the final amplifier tuning control is swung through resonance.

TCZ SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

The transmitter developed a hum on the carrier sounding like about 400-cycle AC. Transmitter output and operation otherwise normal.

The main power fuses failed when the emission selector switch was in CW or MCW position, and excessive sparking at the contacts of K-1904 took place when the emission selector switch was turned to the OFF position.

Cause and Remedy

All stages of transmitter including modulator checked and found normal. Power bay checked and high voltage found normal. Examination of low-voltage dynamotor D1901 disclosed shorted segments of the commutator, Commutator turned down and undercut. Operation normal. Examinations of the commutator showed that this was caused by the use of test prods with sharp points when checking the armature on the assembly line. Examination of the armature in the spare parts showed the same test prod punctures of the segments.

Found L-1904 grounded and the 1150-volt lead grounded. Replaced L-1904 and K-1904, and removed ground on the 1150-volt lead, resulting in normal operation.

**FAILURE OF THE R-F ANTENNA CURRENT METER
IN THE TDD TRANSMITTERS**

Where an efficient antenna has been erected for use with the TDD transmitter, it has been noted in some instances that the antenna current is of such a value as to overload the r-f current meter enough to cause it to burn out.

The specifications of the TDD transmitter call for an output of 15 watts, but the manufacturer purposely designed it for an output capability of 30 to 35 watts to allow for the considerable loss in the large loading coil when used with

a short antenna. If the output of the transmitter is not to exceed 15 watts, when using a fairly efficient antenna, it will be necessary to reduce the power input to the transmitter.

In cases where more than 15 watts output is purposely needed, or if an antenna meter reading is 1.2 amperes with no modulation, the meter should be shunted in order to reduce the reading of the meter to a safe value.

Satisfactory shunts can be made by using four or five turns of #20 or #16 gauge wire, one-half inch in diameter, connected across the meter terminals.

RELOCATION OF RELAY ON POWER SUPPLY PP-338/U USED WITH TDE TRANSMITTERS

A suggestion proposed remounting relay K-101 of power supply PP-338/U. Presently this relay is mounted on the under side of the chassis which renders it extremely difficult to maintain and inspect. Mounting this relay on the upper side of the chassis as shown in figure 1 will effect a saving of time and personnel in the maintenance and repair of this unit. The modification requires construction and installation of a simple angle bracket, as shown in figures 1 and 2. The leads to the relay may be brought up through a rubber grommet, as shown in figure 1. The modification may be performed by Navy Yard personnel using standard stock material. No special tools are required.

FAILURE OF THE LIFTING EYES DURING THE INSTALLATION OF TDE TRANSMITTERS

Extreme care should be exercised in handling the TDE series transmitter units when using the lifting eyes provided thereon. Preliminary reports indicate that there is a possibility of seriously damaging the equipment when unusual strain is placed on any one of the lifting eyes.

DISCREPANCY IN TUNING CURVES FOR TDE SERIES EQUIPMENTS

The tuning curves in the instruction book for the TDE series transmitters do not give the correct dial settings for proper tuning of the equipment. All ships and stations using TDE series equipments are warned to look out for this discrepancy. While the technical manual curves may be used as a general guide, they cannot be used as an effective tuning device.

Whenever the TDE is set up on a new frequency, the frequency must be checked with a heterodyne frequency

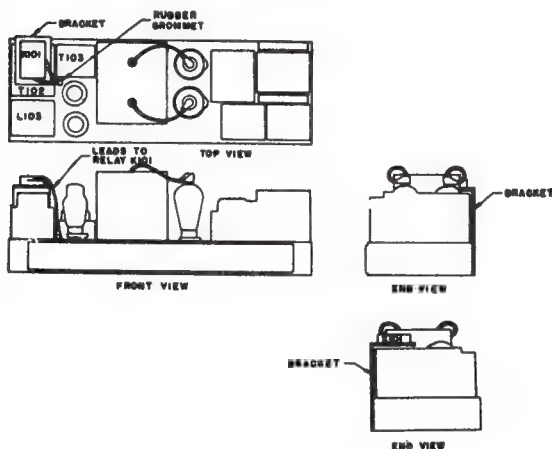


FIGURE 1. Outline of power supply PP-338/U showing location of relay K-101.

ORIGINAL

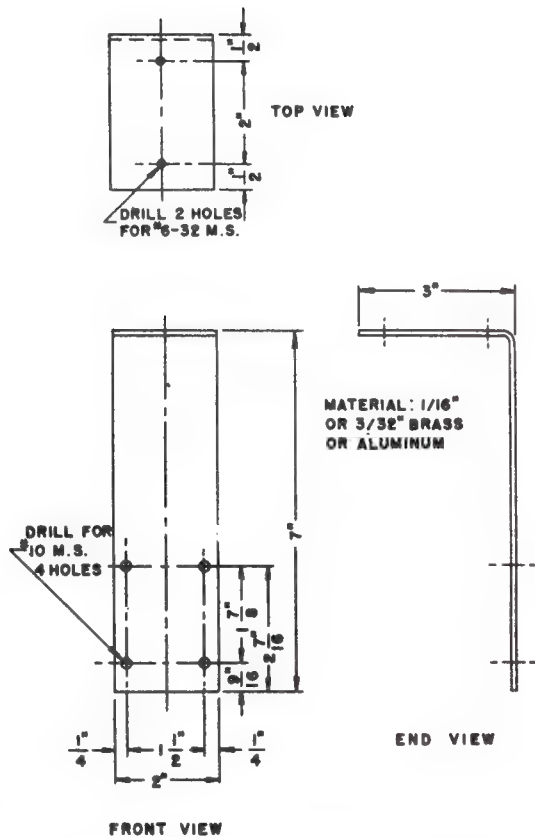


FIGURE 2. Dimensions for bracket to mount relay K-101.

meter and circuits tuned to resonance regardless of the dial settings given in the instruction book.

MODIFICATION OF TDE-1 FOR USE WITH TYPE CAY-23050 FOUR-WIRE CONTROL

An undesirable control characteristic has been found to exist in the TDE-1 115-volt, single-phase, 60-cycle equipment. Normal operation exists when this equipment is used with Westinghouse 4-wire control CAY-23305, Westinghouse 6-wire control CAY-23381, and Navy 6-wire control type CAY-23146.

For the Navy 4-wire control, type CAY-23005, normal operation exists except that one side of the supply line is grounded in the power supply. Therefore, when CAY-23005 4-wire control is used, transformer T-502 must be connected as a "one-to-one" ratio transformer to effect the isolation of the control circuit from the power supply to prevent grounding one side of the power supply line.

A new schematic is provided in Figure 1. The modification is to be made to transformer T-502 as follows:

- (1) Connect links between 1 and 3 terminals and between 2 and 4 terminals. Place both secondary links

TDE:1

between 6 and 7. Make certain that lead from S-507A connects to terminal 1.

(2) Make certain that the lead from S-503B connects to terminal 4.

(3) Make certain that the lead from S-502B connects to terminal 5.

(4) Make certain that the lead from S-504-C connects to terminal 8.

Make certain that terminal 8 is grounded.

CONTROL CIRCUITS FOR THE TDE-2 TRANSMITTER

The transmitter control circuit diagram (fig. 3) which follows was prepared by the staff of the Radio Material

School, Naval Research Laboratory. It is a simplified schematic diagram of the starting, stopping and keying circuits for the model TDE-2 transmitter.

It is not intended for this to be a complete schematic diagram of the entire equipment, but it is believed that it will be a help toward the understanding and servicing of the control circuits of these transmitters.

SAFETY PRECAUTIONS FOR LINE FUSE HAZARD

A potential exists at fuses F-501 and F-502 (in the power supply of TDE) even when the transmitter switches and safety interlocks are open. The solder lugs carrying

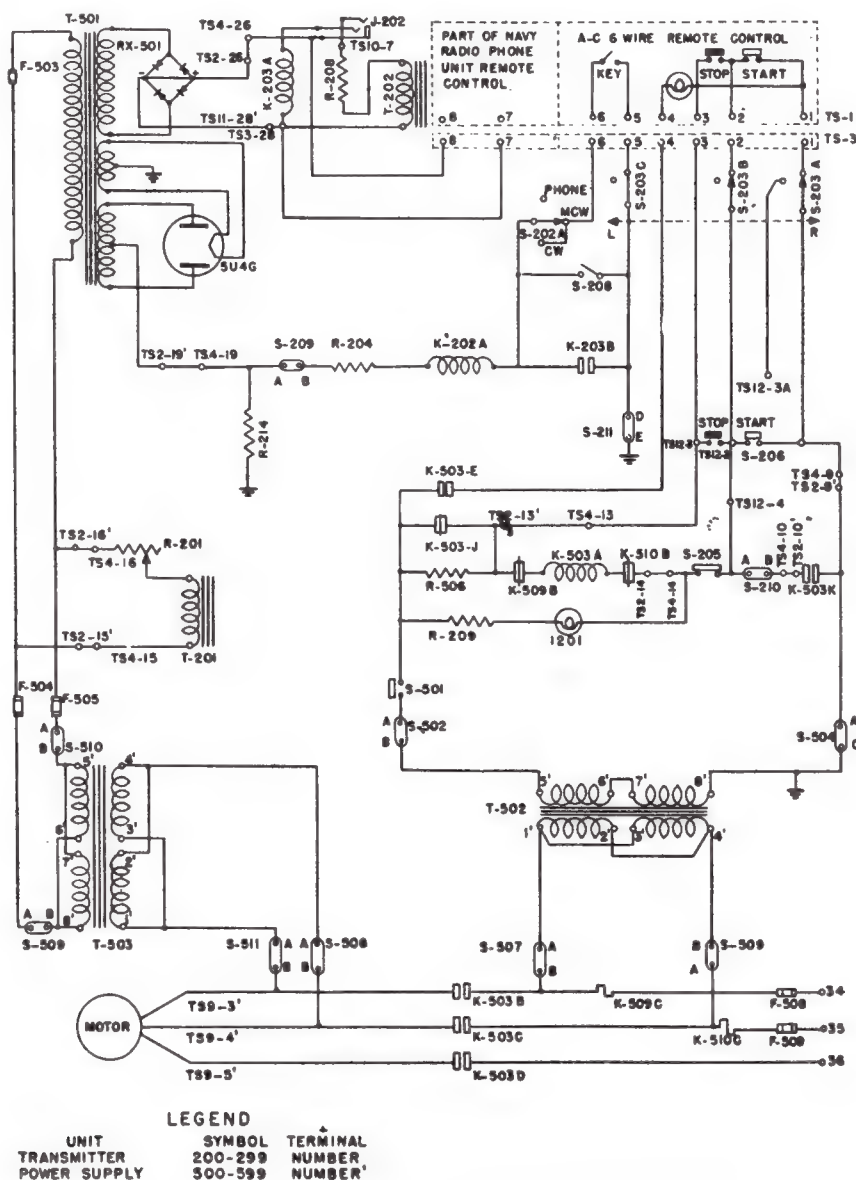


FIGURE 3. Control circuits for model TDE-2 transmitters.

440 volts a.c. to the fuses protrude slightly from under the fuse block protective cover. After the fuse access door is opened or the power supply panel is removed, these lug connections may become a safety hazard unless the main power switch is opened. It is also possible for the access-door stop to contact these lugs if the power-supply panel is allowed to drop when the panel retaining knobs are released. Warning signs on the power-supply panel and on the protective cover over the fuses, indicating the presence of high voltage; and warnings in the technical manual for TDE to open the main power-supply switch before servicing the transmitter, if adhered to, would avoid the hazards described.

It has been suggested changing the type of fuse clips and extending the cover to eliminate the hazards mentioned. In view of the warning signs on the equipment and admonitions contained in the technical manual, the Bureau believes the time and expense required to modify the fuse block or cover is unwarranted. However, in the interest of providing all practical protection to personnel, the exposed solder lugs should be wrapped with vinyl insulating tape as an additional safety precaution.

TDE SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Will not key; or keys only momentarily, falling off when key is held down.

Will not modulate.

Radio-frequency arc-overs.

Start-stop contacts K-503 would drop out immediately upon releasing remote starting button.
No high- or low-voltage output from motor-generator set.

TDE-2.--While tuning the transmitter power-amplifier stage, the plate milliammeter reading was greater than full-scale reading.

Voltage dropped from the normal 2000 volts to 200 volts as indicated by the plate voltmeter.

TDE-1.--Audio signals from model LR-1 frequency meter very weak at audio output jack of TDE-1 transmitter.

TDE-2.--No power to voice relay or microphone transformer. Unable to use voice on this equipment.

Cause and Remedy

Failure when in high-frequency position, replace 837 tube.

Failure when in intermediate-frequency position, replace 807 tube.

Failure when in both positions, replace 5U4 tube.
Check gain control setting (the gain control is easily overlooked) Check K-203-A.

Under certain i-f antenna conditions where characteristics exceed the antenna limits for which the equipment was designed, excessive r-f potentials may be developed. In such cases, reduced coupling (dial S) so that the power-amplifier plate current is reduced to 150 ma. when operating on voltage feed (dial T) below 400 kc. Refer to Fig. 31 in rear of instruction book, also paragraphs 3-54-d, 4-19, 4-23, 4-24, 4-25, 4-28.

Contact K-503J dirty. Cleaning controller contacts restored transmitter to normal operation.

Inspection of m-g set revealed:

- (1) All brushes in good condition.
- (2) Low-voltage commutator in good condition.
- (3) High-voltage commutator smooth but contained many small particles of copper between segments. Apparently, commutator had been turned down but not undercut. Remove armature and undercut the high-voltage commutator. Operation then normal.

When the transmitter switch was placed in ADJUST position, the same condition existed. Failure was traced to capacitor C-631 inside of the motor-generator set by the ohmmeter method. This capacitor was replaced and set operated normally.

Motor-generator was faulty. Voltage measured from low side of motor-generator read 28 volts. Voltage from high side read 168 volts. Replaced armature and shaft assembly, which resulted in normal operation of equipment again.

Checked for ground and discovered that the wrong side of the jack at the frequency meter patch panel was grounded. Normal operation was restored by reversing wires at patch panel.

Jumper missing between the two filter reactors. Installed missing jumper and set worked.

TDE SERIES TROUBLE SHOOTING NOTES --Continued

Difficulty Encountered

Output generator voltage would not exceed 140 volts.
Motor-generator set not operating correctly.

Motor-generator set would not start, K-503-A relay did not operate normally, pilot light did not go on, transformer I-502 began to "smoke." The brushes in the motor-generator set apparently were much too hard and the commutation was continually "grooved". After each grooving, the equipment had to be taken apart and a cut had to be taken on the commutator, resulting in the equipment frequently going off the air.
No power output. Motor controller arced excessively.

Low-frequency power-amplifier would not resonate.

Master-oscillator calibration dial reading on high-frequency master-oscillator variometer tank coil was about 200 divisions off from calibration curves.

TDE-2.--Transmitter would start when start button was depressed but would stop as soon as button was released.

The microphone would not operate when plugged into the remote control unit.

A fuse was continually blowing. The set was inoperative.

High-voltage meter (M-205) indicated 2500 volts and could not be adjusted to proper voltage by R-501 the field rheostat.

TDE-2.--While transmitter was being keyed, output suddenly ceased.

Cause and Remedy

The generator is of the self-exciter type. The voltage would build up to about 140 volts due to residual magnetism. Indications showed that the high-voltage winding was not receiving excitation from the low-voltage or 550-volt winding. It was found that the low-voltage winding of the armature was shorted. The armature was replaced and the generator returned to normal operation. Checked T-502 and found the two secondary windings shorted out. Replaced T-502 and normal operation was resumed.

Hard brushes replaced by softer brushes. Softer brushes were shaped to fit the motor-generator and all the hard brushes were replaced. Equipment operated satisfactorily from then on.

Loose connections to relay KV502 in motor controller found. Inspection disclosed dirty and burnt relay contacts. Contacts were cleaned and burnished. The unit then operated normally.

Visual inspection showed p-a tank capacitor C-123 to be cracked and swollen. Bridge measurements gave capacity to be about .001 mfd., insulation resistance about 2 megohms. After the capacitor was replaced, the equipment operated normally.

Variable portion of coil slipped out of proper adjustment due to loose coupling collar on shaft--caused by deterioration of gasket material and continued "salvo" shock. The master-oscillator was set on a known frequency, and the coil held firmly in place by hand while dial was adjusted to proper reading. The coupling was tightened.

Starting contactor K-501 contact points were found to be fused together. By separating the fused points, normal operation resulted.

Both the key and the microphone worked at "Local" position, and the key also worked from the local "Remote" position. In the transmitter, rough contact points were discovered on the LOCAL-REMOTE switch. Equipment worked perfectly after contacts were filed smooth.

Upon attempting to "fire up" the transmitter, a fuse blew. Upon replacement of the fuse it blew again. Meter readings showed a short in the plate circuit of the master oscillator. This was found to be caused by a small nut wedged to the gear causing a complete short. This nut was removed, the choke (which had burnt out) was replaced and the operation of the equipment was returned to normal.

Found loose screw lying on TS-8 from LV-F to grounded lead sheath of cable. This shorted out R-501.

It was found that M-201 (power-amplifier plate current meter) was "pegged" by excessive current without the transmitter being keyed. M-201 is in the negative return of the high-voltage generator and is grounded on one side. Checks with an ohmmeter revealed that C-631 was shorted, grounding the positive side of the high-voltage

TDE SERIES TROUBLE SHOOTING NOTES -- Continued

Difficulty Encountered

TDE-2.--Antenna lead ran too close to h-f contact on A switch causing a break down or arc whenever the i-f section was loaded enough to draw over 60 ma. plate current.

TDE-2.--Master oscillator did not oscillate continuously, but in short pulses at the rate of about 120 per minute.

TDE-1.--Transmitter keyed erratically and with lower than normal current readings. Finally would not key at all on h-f side, while OK on i-f side.

TDE.--Gear would work normally for a few minutes and then the p-a plate current meter would show the normal key closed reading with the key open.

TDE-1.--Excessive sparking when tuning the p-a tuning dial (dial J). A burning odor and smoke was also observed.

TDE-1.--Transmitter on the air continuously.

TDE.--Smell of hot insulation.

TDE-3.--Transmitter keying continuously, on TUNE or OPERATE position of switch.

TDE.--High voltage was arcing to the HF-IF switch (S-214) vertical control, when set to the IF position and the TUNE-OPERATE switch at OPERATE.

TDE-1.--Transmitter would not stay in operating condition.

TDE-1.--Transmitter would go off and on at will or with a slight jar.

TDE-2.--Both line fuses blew as soon as power was applied.

Cause Remedy

generator and placing M-201 directly across the generator. When C-631 was replaced, normal operation was restored.

Remedied by bending lead away from h-f contact.

The pulses of operation were of much shorter duration than the periods between pulses. The power-amplifier plate current was steady at about 115 milliamperes with TUNE-OPERATE switch in either position. It could not be dipped. The intermediate-frequency master-oscillator grid resistor, circuit symbol R-102 was checked with an ohmmeter and was found to be several megohms. Replaced the defective resistor and the set thereafter operated satisfactorily.

Found master-oscillator grid lead R-302 grounded on both sides. Traced circuit and found the stiff bare wire from C-302 to S-301B was in contact with the chassis. Probably caused by vibration. Repaired equipment by bending the wire away from the chassis.

Found to be due to a defective p-a grid current meter bypass C-208. Replacement of this capacitor cleared the trouble.

Found to be due to poor insulation on wire leading from cap of V-303 to C-328. The wire was shorted by a screw on C-328.

Found wiring wedged under microphone relay K-203 causing continuous contact which in turn energized the keying relay (K-202) continuously.

Inspection showed that the p-a stage had lost its grid bias and the bias rectifier tube V-301 (type 5U4G) had red hot plates. Sparking was observed around the switch S-209 which was loosened from its frame and checked for grounds and shorts. None were found, but it was noted that the insulation had worn through on some wires that had been previously taped up. Reinsulating these wires cleared the trouble.

Traced the trouble to short in microphone relay coil K-203 circuit causing coil to be energized and holding contacts K-203A shut. Replaced relay.

This was due to a screw becoming loose that held a rod at the bottom end, allowing the rod to come close enough to a screw holding the HF-IF capacitor to draw an arc from it. Tightening this screw restored equipment to normal operation.

Found that relay K-501 contacts were not "making" and that some were burned. Replaced contacts.

Found interlock S-205 cracked and loose on its holder. Replaced.

Replaced shorted START-STOP switch. Fuses blew again due to improper sequence of operation in motor starter. Corrected by tracing wiring and changing improper connections. Motor then ran OK, but no output on h-f side.

TDE SERIES TROUBLE SHOOTING NOTES--Continued

Difficulty Encountered

- TDE-2.--Transmitter failed to key on CW, MCW, or PHONE on either IF or the HF side. F-503 blew when transmitter was keyed.
- TDE.--Radiating when not keyed. Audio tone picked up on received tuned to same frequency. I-F amplifier grid current 3 ma. Condition existed only in TUNE and OPERATE positions.
- TDE.--Erratic operation of transmitter from remote position. Normal operation from local position.
- TDE-2.--The bias rectifier fuse, F-503, kept blowing out.
- TDE-3.--Low and distorted output on voice. Too low to be received.
- TDE-1.--On the PC-1176 the line fuse would blow as the motor turned over.
- TDE-3.--When the transmitter was tuned to any frequency on either the intermediate or high frequency bands, and a receiver tuned to the same frequency, an audio note could be heard which cut out at stations. This happened in the TUNE and OPERATE positions only of the ADJUST-TUNE-OPERATE switch.
- TDE-3.--The TDE-3 which was operating on 4295 kc, kicked out when the adjacent TBA-11 was keyed. Arcing was noted in the motor-generator compartment and the odor of burnt insulation was present. The TDE-3 was started, overload reset and the following indications noted: (a) PA plate current meter hit the peg. (b) Plate voltage below normal and not adjustable. (c) Fuse F-507 continued to blow.
- TDE.--At the time the low frequency section M.O. was adjusted for zero beat with the frequency meter, a low audible beat was heard. It extended over the complete range of the M.O. When the test key was pressed, all meters read low and fluctuated with the frequency of the audio note in the phones.

Cause Remedy

- Replaced gassy 803 tube. Operation OK at high frequencies but poor in 2-mc. band. Changed antenna to a longer one and then finally all OK.
- The bias rectifier filter capacitor C-501 was found to be leaky. Checked 175 ohms. Replaced.
- C-301 found leaky. Keying is accomplished by grounding the cathode. This cathode capacitor leaking to ground furnished partial keying and radiation was strong enough to be picked up by receiving antenna.
- Contact K-503K was binding occasionally. The cotter pin, holding the spring on the shaft, had worn into the bakelite guide pin on which it traveled. Made a new guide pin of bakelite and installed. A new cotter pin was installed and carefully centered to make as little contact with the bakelite guide pin as possible. Cleaned contacts. Transmitter resumed normal operation.
- Contact #28 on terminal board 11 had shorted to ground. Short was cleared. Normal operation restored.
- Circuit tracing showed a near short circuit across the primary of audio transformer T-202 caused by lugs of terminals 3 and 6 in CFN-23381 remote control unit being soldered together. Removed soldered connection and equipment operated properly.
- Removal of the 2000-volt d-c brushes returned the motor to normal operation. Replacement of these brushes again resulted in blown line fuses, but it was noted that the high-voltage fuse F-506 remained unharmed. Capacitor ground was found shorted and replaced. Gear operated normally.
- C-631 that runs from the positive high-voltage brush to the capacitor C-301 between cathode and ground of the intermediate amplified tube V-302 had developed a high resistance to ground. Since plate voltage is applied to the tube when the switch is in either TUNE or OPERATE position, and since keying is accomplished by grounding the cathodes, this high resistance short to ground caused the oscillators and intermediate amplifiers to draw reduced current without being keyed and so radiate a signal. This signal was strong enough to be radiated from the antenna.
- Continuity check revealed a ground between generator and F-506. All other power supply circuits checked normal. Further investigation revealed that terminals HV (pos) and LV (pos) on terminal strip 8 (located on generator) shorted and fused together. The short was removed, leads separated as much as possible, and the equipment returned to normal operation.
- Resistor R-302 was checked and found to read 15,000 ohms. Replaced R-302 and equipment operation returned to normal.

TDE SERIES TROUBLE SHOOTING NOTES--Continued

Difficulty Encountered

TDE--Unable to load antenna, and transmitter arced at HF antenna feed switch.

TDE-1.--Equipment keys continually.

Transmitter keys all the time when in remote position.

Transmitter keys all the time.

Transmitter fails to key.

Transmitter fails to key in remote position.

Oscillator HF or IF oscillates and blocks.

Oscillator (HF side) fails to zero beat on various bands.

HF oscillator output to IA stage is normal except on range 1.

HF and IF readings are not found at right spot on dial.

Low grid drive HF-IF stage.

No Screen voltage to 807 HF and IF side.

No grid drive to grid of 803 HF side.

HF stage fails to resonate properly on all bands.

IF stage fails to furnish enough drive to PA stage.

Low grid drive to HF-IF 803.

PA grid current meter reading in reverse direction with transmitter unkeyed.

Transmitter will operate in tune position.

PA plate current meter reads all the time.

Transmitter does not modulate in phone or MCW position.

No modulation in NCW position.

Cause and Remedy

Found insulation in switch S-304-A broken causing arc. Wafer on switch S-304-B was broken also. Replaced both switches and cleaned contacts on HF-IF transfer switch.

Lead No. 4 on keying relay grounded. Removed ground. Equipment operates normally.

A. Contacts of K202B shorting together.

B. Wires near relay K202B holding relay in operated position.

A. Clear ground in test key ckt.

B. Check for loose wires behind control panel.

A. Check T501.

B. Relay K207A contacts are out of adjustment.

C. Check S208 for proper operation.

D. Check fuse F503.

E. Check link S211.

A. Check contacts and condition of X203.

B. Check for jumper between TS11-32 and TS1-5.

C. Check in link S209.

A. Check R302 HF side.

B. Check R102 IF side.

C. Check L104 IF side.

A. Check S301 contacts.

B. Check C302, C303, C305.

A. Check R301.

B. Check S302A.

A. HF side check alignment of L301 and dial "C."

B. IF side check alignment of L101 and dial "P."

A. HF side adjust C311.

B. IF side adjust C108.

C. Check tubes voltage on HF and IF side.

A. Check C110.

B. Check driver network.

A. L307B shorted to C320.

B. Check R310.

C. Check tube voltages.

D. Check M204.

A. Check S303.

B. Check alignment of dial "G" and C320.

C. Check tube operating voltages.

A. Check tube voltages.

B. Check C-116 and C109.

A. Check R214.

B. Check IF stage.

A. Check C111 in IF section of transmitter.

B. Check C335 in HF section.

A. Check R209.

B. Check S207 for proper operation.

A. Check C631 (in MG on HV end).

B. Check C212.

A. Check C326 HF side.

B. Check C120 IF side.

C. Check gain control R206.

D. Check contacts S202.

A. Check contacts switch S202D.

B. Check ground to case of transformer T203.

TDE SERIES TROUBLE SHOOTING NOTES-Continued**Difficulty Encountered**

HF side loads, but breaks down intermittently.

HF side fails to load.

Motor generator turns over at very low speed.

IF side loads, but breaks down intermittently.

IF side fails to load properly.

Motor generator fails to start, contactor fails to close.

High-voltage meter fails to read.

High-voltage fuse blows.

Voltage output of MG low.

High-voltage meter reads in wrong direction.

Start and stop switch does not stop the transmitter.
(6-wire control circuit).

MG set will run only when start button is held in. (6-wire control).

Pilot lamp 1201 burned out. Voltage to lamp high.
Transmitter operation normal.

Cause and Remedy

- A. Check for loose connections in antenna loading network.
- B. Check condition of roller on L310A.
- C. Check contact of switches S304, S307, and S213.
- D. Check M303.
- E. Check rotor and stator spacing C329, C330, and C328.
- A. Check for loose connections in antenna loading network.
- B. Check condensers C328, C329, and C330 for stator and rotor alignment.
- C. Check roller on L309A and L310A.
- A. C631 (in MG frame under inspection plate) shorted out.
- B. Series field shorted or connected improperly.
- A. Check for loose connections in antenna loading.
- B. Check M102.
- C. Check switch operation of S104, S106, and S107.
- A. Check alignment of dials and switches "R" and L109, "S" and L109.
- B. Check for loose connections.
- C. Check contacts of switches, S104 and S106.
- D. Check M102.
- A. Interlocks S205 and S501 fails to make contact properly.
- B. Contacts K503J out of adjustment, or dirty.
- C. Contacts K509B need adjustment.
- D. T502 links are not in proper position.
- A. Check R205 in MG unit.
- B. Check M205.
- C. Check fuse F506.
- D. Check resistance of terminal 12 to ground.
- A. C212 breaks down under high voltage (no ohmmeter indication of break-down).
- B. Short in HV supply transmitter.
- A. Check MG speed with tachometer.
- B. Check series field.
- C. Check condensers C634 and C631.
- D. Check link board on motor end.
- A. Check polarity of M205.
- B. Check phase relation of line to transmitter.
- A. Link S210 in wrong direction.
- B. Check contact adjustment K503K.
- C. Check circuit for ground.
- A. Check link S210.
- B. Check adjustment of K503K.
- A. Check links on transformer T502.
- B. Check R209, R215.

TDH TRANSMITTER KEYING CONVERSIONS

The following is an excerpt from a Chollas Heights memo: "Operation of the TDH at Chollas Heights is such that use of the remote control unit is undersirable. Use at present is confined to telegraph only-- starting, stopping and frequency changes accomplished by personnel at transmitter upon request--. Changes made are shown in accompanying schematic (Fig. 1);--"

Carrier control of the TCC-TDH equipments without the use of the remote control unit may be accomplished by the use of a 22.5-volt "B" battery in series with the local polarized keying relay, or, if a local relay is not used, by measuring the resistance of the control line loop and calculating the necessary grid voltage for an approximate five-milliampere load. The carrier may be used for either manual or automatic keying or push-to-talk radiotelephone.

At various installations the TCC-TDH transmitters are being fed directly into a non-resonant line antenna system without taking into account that one side of the system is at ground potential. The device explained below and shown in Figure 2 has been used at several installations in the South Pacific.

To realize the full output and gain from directive types of resonant or aperiodic antennas used in conjunction with TCC and TDH transmitters, this auxiliary antenna coupler has been devised and used to great advantage in several installations. "C" may be .0005 mmfd., such as Navy type 48967 or 48968. "L" may be any coil wound with #10 wire or larger with provisions for tap variance, or rotating coil type. "B" may be any convenient length. Experience has shown an optimum point to be anywhere between ten and twenty feet. The pi-matching section of the transmitter will tune with better power transfer to the reflected loads between these points. Tapping directly to the antenna device is to be discouraged as the radiation resistance is normally too low to be matched by the pi-network.

If the range of the frequencies used is limited to the 2- to 8-mc. range, the L/C circuit may be adjusted at a 4-mc. output frequency. Tune the transmitter to a 4-mc. output frequency and adjust "L" to the point where the current is the same in both feeders. If the transmitter is to be used through the full spectrum of operational frequencies, adjust the antenna device for a medium frequency such as 12 mc. The pi-matching section of the transmitter will "look into" the presented reflected load and the transmitter will then operate on any frequency without excessive mis-match. Once the antenna device is adjusted, no further attention is

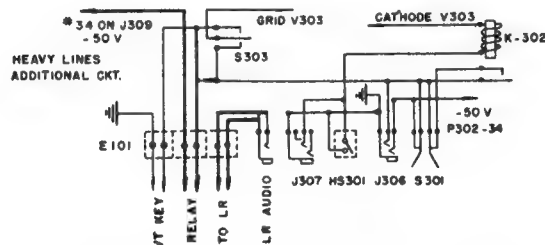


FIGURE 1.--Revised schematic of remote control unit

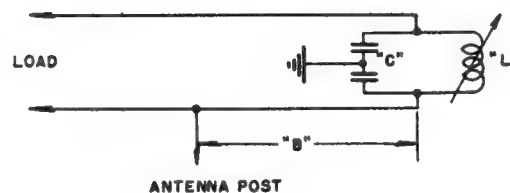


FIGURE 2.--Auxiliary antenna coupler

required. Any resonant (co-linear, lazy "H", extended or double Zepp) or aperiodic ("V" or rhombic) antenna may be fed in this manner.

MODIFICATION OF TDH TRANSMITTING FOR FREQUENCY SHIFT KEYING

The master oscillator circuit of the TDH transmitter is designed for a frequency range of 1000 to 1510 kilocycles. When frequency shift keying is employed for these equipments, it becomes necessary to set the master oscillator frequency 200 kilocycles below the frequency normally employed with on-off keying. As a result, there are certain frequencies that cannot be obtained when frequency shift keying is employed.

In order to alleviate this condition, the Naval Radio Station, Annapolis, modified the TDH transmitter at that activity to the extent of inserting an additional capacity of 0.0013 microfarads across the grid tuning inductors of the TDH oscillator assembly. This modification was made, using this value of capacity connected in parallel with the master oscillator grid tuning capacitor, through a toggle switch in order to connect or disconnect the additional capacity for frequency shift or on-off keying as desired. The frequency range of the master oscillator was found to be from 800 to 1210 kilocycles, with the additional capacity connected and from 1000 to 1510 kilocycles with the additional capacitor disconnected from the circuit. With this arrangement, any frequency within the range of the transmitter could be set up, using either frequency shift or on-off keying as desired.

Any activity experiencing similar difficulty with the TDH series of equipments is authorized to make the above modification, making appropriate records of the modification in the instruction book of the equipment.

SHOCK-HAZARD ELIMINATION IN TDH RADIO TRANSMITTER

A dangerous situation exists in the TDH radio transmitting equipment as a result of a field modification for RATT (Radio and Teletype) operation of the TDH transmitters.

The RATT coupler unit is so installed that when an operator or technician opens the access door to tune the coupler, his hand must pass within 3 inches of the 50-volt bias circuit which is not deenergized by the interlock on

the access door. This voltage is required in order to adjust the oscillator and coupler unit.

The Collins Radio Co., manufacturer of TDH equipment, was contacted and "recommended that a strip of three-sixteenths bakelite approximately 6" wide and of a length equal to the front to back width of the chassis be bolted to the chassis lips at the front and back of the power amplifier chassis. The conditions hazardous to operating personnel would then be essentially eliminated and this would not have a detrimental effect on the ventilation of the transmitter."

All activities using the TDH equipment please note that such a hazard exists and initiate action to eliminate this dangerous condition.

FIELD REPORTS ON TUNING DIFFICULTIES OF THE TDH

Experience with the TDH master-oscillator auto-tune control has shown this unit to be extremely critical. The difficulties encountered when setting up the full eleven channels are proportionate to the skill of the operator in setting the control stops.

On the lower frequencies any slippage during the calibration of the stops other than the one being calibrated may be slight and the frequency tolerated will not be overstepped. But this slippage, however minute, will be multiplied in the process of doubling to the higher frequencies and the variation will be considerably greater.

To adjust the stops to a new frequency loosen the lock-nut just enough to allow movement of the cam stop. By setting the cams on a rough adjustment from the instruction book curves on the high side and then bringing them into the calibrated frequency with the stop bearing against the pawl less trouble will be encountered with slippage.

In tests run on six hundred dialing operations of eleven channels on a TDH, 579 operations or 96.5 percent reset within a frequency tolerance of .005 percent. For this test the transmitter was set up in the laboratory and was operated under more or less ideal conditions. Transmitters that are in operation in advance base locations can expect variance from these results due to failures caused by high humidity and salt-water corrosion.

Due to the constants of the circuits involved, it will be necessary to check each calibrated frequency upon re-dialing before turning the transmitter over to the control operator. Shortly after the initial installation of the transmitter, resetting faults should fall to a minimum and such close monitoring will not be required. The ideal setup for this equipment would be a micrometer assembly (TCT) for fine adjustment while using the auto-tune control for rough settings.

Weather changes have a marked effect on the power-amplifier loading. Day and night variations will overload the transmitter, causing the protective relays to trip and close the equipment down. Other antennas in close proximity to that of the TDH will also have a marked effect on the loading. It is suggested that the equipment be tuned to 100 milliamperes less than the maximum loading to afford a margin for these absorptions.

COLLINS AUTOTUNE SYSTEMS IN TDH-3 RADIO EQUIPMENTS

The following information may be of value to those engineers and technicians on duty with the Navy or at overseas stations:

At several locations erratic operation of the Collins Autotone systems have occurred, which caused the autotone meter fuses to blow. At first this failure will be infrequent but will increase in frequency as time passes and unless corrected, will cause the equipment concerned to be useless for remote control or multichannel work. This trouble is most prevalent with the type TDH-3 kw transmitters. The fuses blow when the phase is shifted to reverse the direction of rotation of the motor. The equivalent circuit is sketched on figure 1.

The contacts on K-103 were found burned badly and when changed the trouble cleared only to reappear a few months later. Condenser C-164 in each case was found to be in good condition, but just to be sure was changed. A closer analysis was made and it was noted that excessive sparking occurred at the contacts of K-103 when less than six (6) mfd capacitance was used from the contacts of this relay to ground. This sparking causes an eventual breakdown of the insulation between circuits on the movable arm of K-103 and occasionally the a-c supply will break across

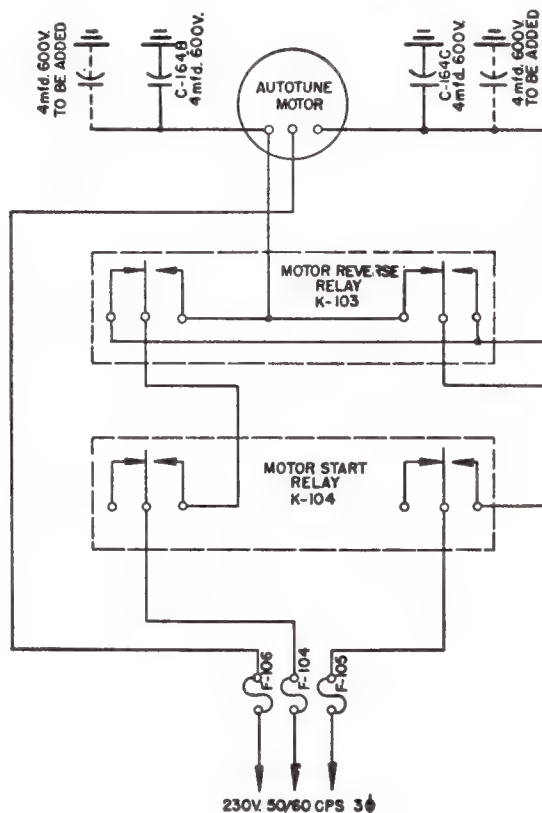


FIGURE 1.--Equivalent circuit of autotune system

this poor insulation and short the two phases together, thereby blowing the fuses. Capacitor C-164 was paralleled with 4 mfd on each side and relay K-103 changed. This completely eliminated the trouble and on a new installment completed a few months ago this modification was made on C-164 and K-103 has remained in good condition and given good service.

TDH-4 TRANSMITTER DISCREPANCIES

During the initial testing of a TDH-4 transmitter, it was observed that the plate blocking condenser, symbol C-155, would arc over upon application of high power plate voltage for A-1, and on peaks when A-3 operation was used. These arc-overs were apparently due to parasitic oscillations causing C-155 to corona and short the plate supply to ground through coils, symbols L-123, L-125 and L-126.

Circuit investigation indicated discrepancies between figures 81 and 82 of the TCH-4 technical manual.

(a) Parasitic damping resistor, symbol R-174, shunted across L-101 was shown on figure 81 but not on figure 82. Further investigation disclosed that this resistor was omitted in the transmitter.

(b) Choke, L-139, is shown between the plate of the power amplifier stabilizing tube V-116 and the power amplifier grids on figure 82 while on figure 81 the plate of the stabilizing tube and the grids of the power amplifier tubes are directly connected. The transmitters were incorrectly wired, i. e., according to figure 81.

It is requested that all activities receiving TDH-4 transmitters check the equipment for the above discrepancies. The spare parasitic dampening resistor, R-174, contained in the spare parts, should be installed and the power amplifier grid parasitic suppressor choke, L-139, should be rewired and connected as shown on figure 82.

Figure 1 is a corrected diagram of the final amplifier showing the proper placement of components.

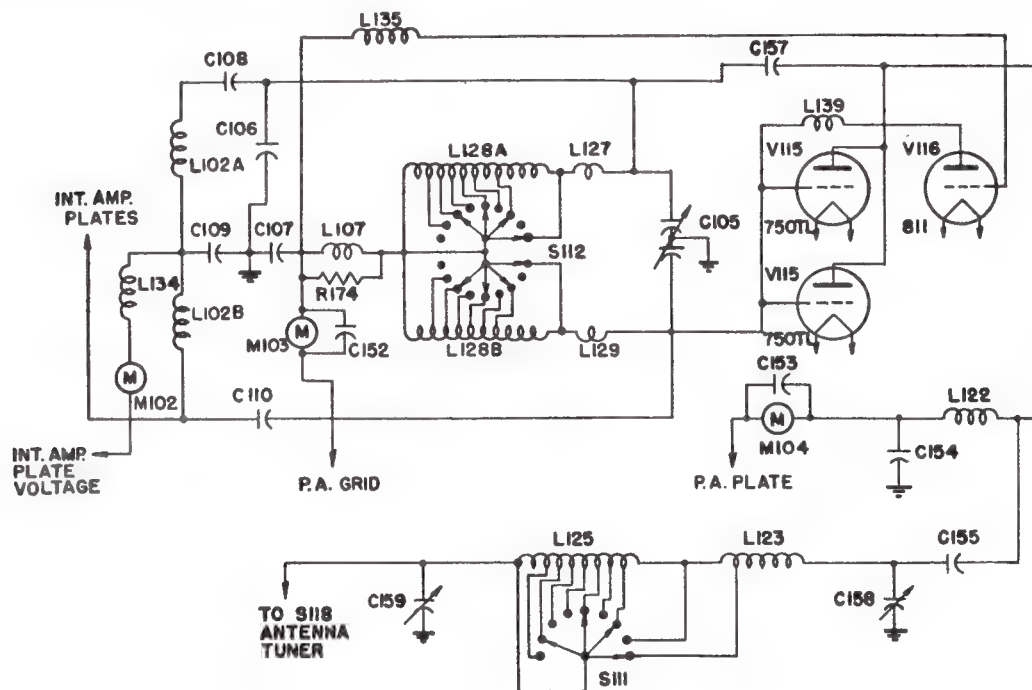
The Bureau has no information relative to the number of equipments shipped possessing the above discrepancies; however, it is probable that all technical manuals contain the errors enumerated herein. Figure 81 should be corrected according to the accompanying diagram.

TIME DELAY RELAYS IN TDH AND TDO TRANSMITTERS

The Bureau's attention has been directed to the unsatisfactory operation of the time delay relay, circuit symbol designation K-114, installed in the models TDO and TDH transmitters. This relay is used to delay the application of plate voltage until the tube heaters have reached operating temperature, the normal time of delay being set at forty-five seconds.

It has been pointed out that the operation of these relays has been erratic, some remaining open, some closed, while the closing time of others would vary from five seconds to over a minute, regardless of adjustment.

Inasmuch as the models TDO and TDH transmitters are intended to be installed in remote, unattended locations,



*FIGURE 1.--Corrected wiring diagram of TDH-4 final amplifier

COMMUNICATIONS**NAVSHIPS****900,000.1****SERVICE NOTES**

the failure of this relay makes it necessary in such cases to establish a watch in order to operate the relay manually. Some activities have solved the problem by the installation of thermal type or telechron operated relays.

In order that the Bureau may take the necessary action to replace those relays found defective, it is requested those activities having experienced this failure make the proper report, giving all necessary information.

REVERSING RELAY FAILURE

The autotune motor reversing relay, symbol K-103 of the TDO and TDH transmitters has failed on several occa-

sions. This failure is most easily identified by the fact that the autotune motor runs continuously and cannot be reversed. Failures of the above relay have usually been due to shorted turns, resulting in a total resistance of approximately 20 ohms. Normal resistance should be approximately 170 ohms.

FREQUENCY METER CONNECTIONS FOR TDN EQUIPMENT INSTALLED IN THE MBK TRAILER

The patch board panel, type CFT-23472, as supplied with the TDN equipments, includes a voltage divider consisting of a 3000-ohm and a 10-ohm resistor which are normally connected in series across the output of each r-f oscillator type CFT-35059. Voltage for making frequency measurements is obtained by connecting a transmission line across the 10-ohm resistor and feeding it by means of this line to the frequency meter. In the MBK installation, considerable cross-modulation resulted when this equipment was installed in the trailer.

It was found that the difficulty was eliminated by simply connecting the 10-ohm resistor across the receiving end, instead of the sending end of the transmission lines connecting the patch board panel to the frequency meter jacks. Consequently, the MBK trailers are wired in this manner. The change from the TDN to the MBK connection is shown in Figure 1.

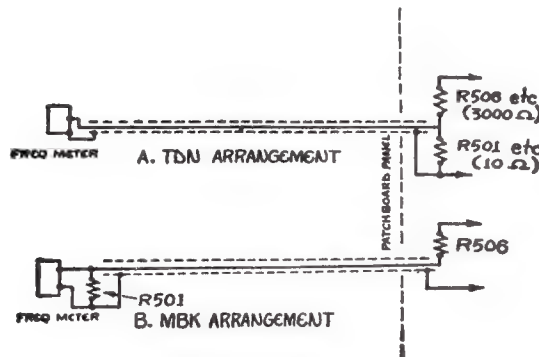


FIGURE 1.--Frequency meter connections for model TDN equipment installed in the model MBK trailer

TDN TRANSMITTER BLOWER MOTORS

The Bureau has received several failure reports of the blower motor, symbol B-1, a component of the TDN-3 transmitter. Cause of failure apparently has been clogging of the ventilator screen in the rear of the motor. This has resulted in overheating and consequent shorting of the motor field coil.

It is requested that all activities possessing the TDN series of equipments ascertain that the ventilator screen behind all blower motor units be cleaned regularly. Each TDN has a sufficient number of spare blower motors enclosed in the spare parts kit.

RELOCATION OF OSCILLATOR CONTROL CONDENSER

TDN equipments using crystal control require that the crystal oscillator circuits be retuned periodically due to

ORIGINAL

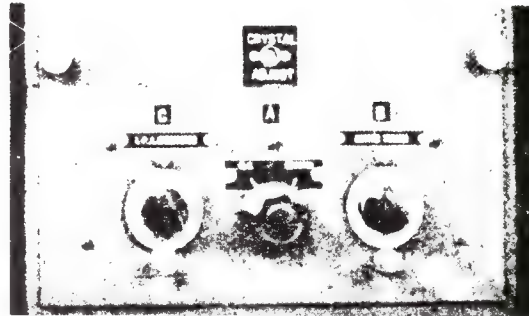


FIGURE 1.--Front panel of TDN equipment showing location of crystal adjust capacitor C-1

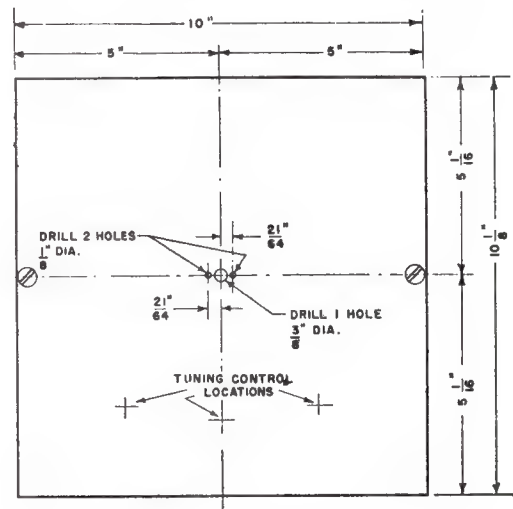


FIGURE 2.--Template for relocation of TDN capacitor C-1

change in ambient temperature, frequency adjustment and checking. The tuning adjustment for this transmitter is condenser C-1. It is accessible only by drawing the crystal oscillator compartment forward from the transmitter. When the oscillator compartment is reinserted, the flexible cables connected to it do not pass backward readily between the oscillator section and the transmitter frame opening. When this occurs, the cables jam and prevent closing the oscillator section. This necessitates withdrawal of an entire transmitter section to adjust the cables to provide for closing of the oscillator compartment. Safety requirements dictate that all transmitter sections, using the power supply providing power for the transmitter being adjusted, must be secured so that this cable may be properly placed.

The Bureau has authorized a modification to the TDN which eliminates the necessity for possible disabling of four (4) circuits when making frequency adjustment on one (1) transmitter section.

This modification consists of relocating the crystal oscillator control condenser C-1, to the inside of the oscillator compartment front panel as shown in Figure 1. This control is presently installed on the oscillator compartment deck. It is required that three (3) holes be drilled in the

TDN:1

COMMUNICATIONS**NAVSHIPS****900,000.1****SERVICE NOTES**

front panel as shown in Figure 2. The lead from the crystal socket to C-1 is threaded through a grommet inserted in the shaft hole of the original position of condenser C-1. A ground wire is then installed from C-1 to the crystal socket mounting screw.

This modification is to be made on an optional basis. No kits or parts are to be supplied, nor are any special tools required.

NOTES

1. Drill 3 holes in panel for relocation of C-1.
2. Install insulated bushing in shaft hole of original position of C-1 for lead from crystal socket to C-1. Install ground wire direct from C-1 to crystal socket mounting screw.
3. For circuitry see NAVSHIPS 900, 709, FIG 2-44.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****HEATERS SPARES FOR TDO TRANSMITTERS**

Heater spares for use with TDO transmitters on contract NXs-20834 will soon be available. These are 3/4-amp. Slo-Blo fuses, part no. 264N427. Requests for these parts should be made direct to the Supply Officer for Radio of the activities indicated, referencing contract and part numbers.

TIME DELAY RELAYS IN TDO TRANSMITTERS

See the article entitled "Time Delay Relays in TDH and TDO Transmitters" in TDH series.

REVERSING RELAY FAILURE

See the article entitled "Reversing Relay Failure" in TDH series.

ORIGINAL**TDO:1**

CONTROL CIRCUITS FOR THE TDQ TRANSMITTER

The transmitter control circuit diagram (Fig. 1), was prepared by the staff of the Radio Material School, Naval Research Laboratory. It is a simplified schematic diagram of the starting, stopping, and keying circuits for the model TDQ transmitter.

It is not intended for this to be a complete schematic diagram of the entire equipment, but it is believed that it will be a help toward the understanding and servicing of the control circuits of these transmitters.

CAUTION NAMEPLATES FOR MODEL TDQ TRANSMITTER

Quantities of caution nameplates for model TDQ transmitters, field change No. 3, contract N5sr-14265P (refer RIB 160), have been shipped to supply activities as follows:

Qty.	Invoice No.	Destination
200	590944	Electronics Supply Officer, Norfolk Naval Shipyard, Portsmouth, Va.
200	590957	Supply Officer, Naval Supply Depot, Electronics Control Branch, Bayonne, N.J.
200	590960	Electronics Supply Officer, Boston Naval Shipyard, Boston, Mass.
200	590958	Electronics Supply Officer, Charleston Naval Shipyard, Charleston, S.C.
200	590959	Electronics Supply Officer, Philadelphia Naval Shipyard, Philadelphia, Pa.
200	591056	Supply Officer, Naval Supply Depot, Electronics Control Center, Electronics Supply Branch, Bayonne, N.J.
1,000	591071	Electronics Supply Officer, Naval Supply Depot, Mechanicsburg, Pa.
200	591059	Electronics Supply Officer, Naval Shipyard, Terminal Island, Calif.
200	591058	Electronics Supply Officer, Mare Island Naval Shipyard, Mare Island, Calif.
200	591057	Electronics Supply Officer, Puget Sound Naval Shipyard, Bremerton, Wash.
200	591060	Electronics Supply Officer, Naval Supply Depot, Electronics Supply Branch, Oakland, Calif.
6	591070	Supply Officer, Naval Research Laboratory, Anacostia, Washington, D.C.

Additional kits of the caution nameplates will be supplied as they become available. Electronics officers should ascertain that all TDQ transmitters in their jurisdiction are provided with the nameplates.

LENGTH TDQ ANTENNA TRANSMISSION LINE

Paragraph 4.16 (a) of the pre-preliminary technical manual covering the model TDQ transmitting equipment specifies that the antenna should not be more than 100 feet from the transmitter unit. This limitation in length of transmission line is not intended to be restrictive to the extent of causing improper installations or preventing installations of the equipments in certain types of vessels.

The 100-foot limitation may be exceeded where necessary to accomplish the most efficient installation, from the standpoint of location of units; but the over-all cable length, in any case, shall be held to the absolute minimum, consistent with the above. As is true for all such transmission lines, the efficiency decreases considerably as the length of the line increases.

One hundred feet of type RG-10/U or CASSF-50-1A transmission line cable is furnished with each equipment; however, this length of cable may be turned into stock and a longer length substituted where required. Splices in this class of cable are difficult and should be resorted to only in cases of necessity. In such cases, the splice shall be in strict accordance with instructions contained Splicing Instructions RA 62A 299.

TOOL FOR CONTACT ALIGNMENT

A beneficial suggestion submitted by Mare Island Naval Shipyard makes provisions for aligning the spring contacts in the rear drawer connectors of the TDQ transmitter. By use of this contact alignment tool the procelain connector may be assembled in much less time than normally required to align these twelve (12) contacts and insert them into the top half of the procelain connector.

The tool is composed of two pieces of 1/16" sheet-brass formed as shown in Figure 1. The two comb-like pieces are inserted from adjacent sides of the contact assembly as shown in Figure 2. This compresses and aligns the spring contacts which allows the top half of the contact assembly to be easily placed in position. The tool is then withdrawn and the connector secured to the chassis in the required manner.

The tool can be made by station personnel from scrap pieces of brass.

ANTENNA FAILURES IN TDQ V-H-F RADIO TRANSMITTING EQUIPMENT

Several reports have been received by the Bureau recently concerning failure of the Type 66095 antenna as

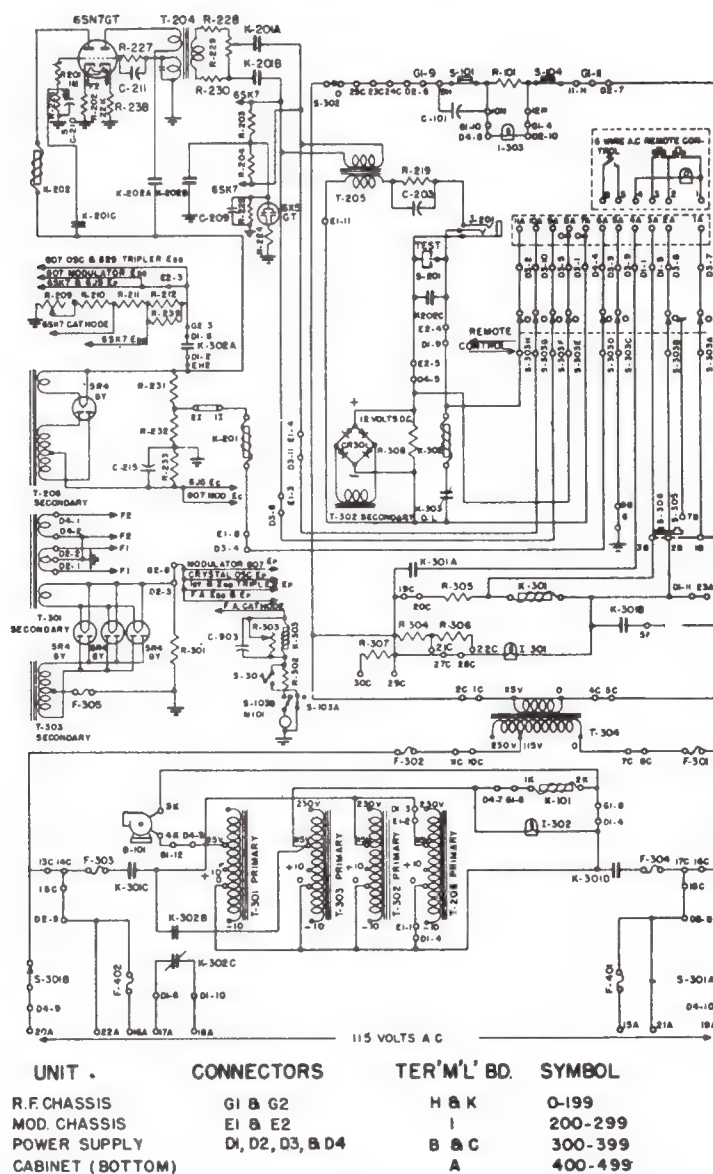


FIGURE 1.--Control circuits for model TDO transmitters

used with the TDQ equipment. Many of the reports state that the mounting-gaskets deteriorate over a period of time, allowing moisture to enter the housing and thereby grounding the antenna. Investigation reveals that these faults can be attributed either to poor installation or to loosening of the bolts by vibration.

As to the former cause, installing activities are cautioned to install the gaskets and insulators properly and to make sure that the bolts are drawn up tight. Glyptol should be applied to the bolts to aid in preventing them from becoming loose.

Vibration is the cause of the majority of failures. It is therefore necessary that the Type 66095 antennas be inspected for low resistance and grounds more frequently

than is done in routine maintenance procedure. It is recommended that the arrays be disassembled and inspected when low-strength radiation and reception are experienced. Failures of this type cannot be determined by visual inspection alone. After inspection and cleaning, the arrays should be reassembled. New gaskets should be used and care should be taken that the gaskets and insulators are installed properly and that the bolts are drawn up tight. Glyptol should again be applied to the bolts in each instance to insure against loosening due to vibration.

To illustrate the importance of close inspection and proper maintenance, a number of cases have occurred where requests were made that the antenna be relocated. Investigation disclosed that the antenna had a ground or short.

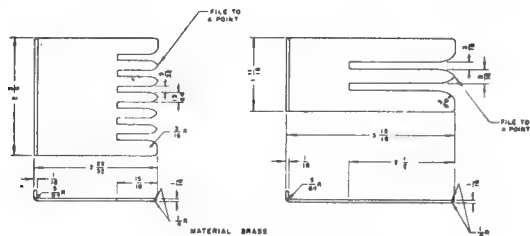


FIGURE 1.--TDQ contact alignment tool

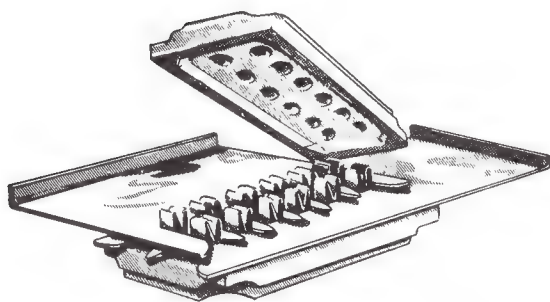


FIGURE 2.--Illustration showing the use of the TDQ contact alignment tools

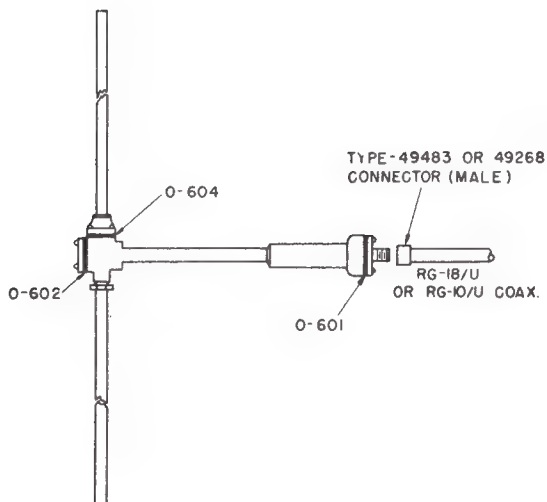


FIGURE 1.--Location of TDQ gaskets to be checked on antenna

After the antennas were repaired, the efficiency was brought up to such a degree that the need for relocation was unnecessary.

The gaskets are carried as part of the equipment, tender, and stock spares. Figure 1 is an illustration of the antenna, and shows the gaskets, O-601, O-604, that should be checked.

FAILURE OF TDQ ANTENNA CONNECTORS

The Bureau has received several reports from ships concerning failure of the type 66095 antenna assembly for the TDQ equipment, the failure being due to the collecting of water in the antenna and coaxial connectors.

This trouble is not due to defective design in the equipment, but to poor workmanship or improper installation of the antenna assembly and connectors.

Ships are urged to check their TDQ antennas for this condition and, if found, to effect repairs at once. Collection of water in antenna systems may be detected by "megger" or insulation resistance tests on the connecting cables supplemented by actual inspection. Special attention should be paid to antenna insulation resistance measurement during the routine check-up, as this will detect the subsequent collection of moisture.

FAILURE OF TDQ TRANSMITTERS

The post-graduate school, U.S. Naval Academy, Annapolis, has reported to the Bureau two defects in the construction of the TDQ transmitter. This activity has found that the output coupling loop L-105 occasionally shorts to the power-amplifier tank inductance L-104 when the system is adjusted for maximum coupling. They have also found that the control grid lead of the second tripler tube V-103 sometimes shorts to the metal shield.

Other maintenance activities encountering these difficulties are requested to so advise the Bureau in order that they may be brought to the contractor's attention and eliminated.

DAMAGING THE KEYING RELAYS OF TDQ EQUIPMENTS

There is very little clearance between the m-c-w keying relay K-201 and the mounting rack, and that if the modulator chassis is not carefully removed from the frame the relay will catch in the rack and be bent.

This matter should be brought to the attention of all maintenance personnel in order that the relay may not be inadvertently damaged when removing the modulator chassis from the frame.

ADAPTING TDQ AND RCK FOR CCL SERVICE AT SHORE STATIONS

The following field changes are recommended in order to relieve the shortage of the TDG-1 and RBQ-1 transmitter and receiver which are presently utilized with the UN (Western Electric Type 42-A-1) Carrier Control System and also in order to fully utilize the capabilities of the Army Type CF-1 four-channel telephone terminal when utilized alone or when the Type CF-1 terminal is utilized with the UF carrier telegraph equipment.

To obtain best use of the Army Type CF-1 telephone terminal the u-h-f transmitter and receiver should have a flat frequency response up to 12 kc. The unmodified TDQ transmitter is down about 16 db at 10 kc and the unmodified RCK receiver is down about 8 db at 10 kc when band switch is set to "wide."

In their present form the TDQ/RCK combination will permit use only of channels one and two of the four channels of the Type CF-1 terminal.

CRYSTAL FAILURES IN TDQ RADIO RECEIVING EQUIPMENTS

See article entitled "Crystal Failures in RCK and TDQ Series Equipment", in RCK series.

TDQ SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

No ventilation from blower.

Unable to load plate current any higher than 100 milliamperes.

TDQ.--Line fuse blew when START button was pressed.

TDQ.--Intermittent and erratic operation of the crystal oscillator.

Short-circuit between tank coil and coupling link, thus grounding the d.-c. supply.

Unable to key the transmitter from either local or remote positions.

Cause and Remedy

Check clamp around canvas blower boot where boot joins ventilation tube. This clamp works loose. Canvas tube may be seized in place.

The coaxial transmission line was found to be broken. Upon repairing transmission line, transmitter operated normally.

Investigation showed signs of T-206 overheating as evidenced by smell of hot pitch and leakage of pitch out of corners of transformer case. Disconnected T-206 and checked all circuits connected to it. All O. K. Next checked windings of T-206. Found primary had resistance of 2 ohms instead of 7.2 ohms.

Bureau comment: Other ships having this difficulty are requested to supply the Bureau with details as there is some evidence that this might be due to settling of the transformer in its case and shorting out the windings. If so, replacements under the guarantee can be secured. Found braided wire connecting the crystal plate and the crystal holder had become frayed so that only one or two strands were still connected. Replaced wire to effect a cure.

Eliminated future similar trouble by covering the tank lines with spaghetti in the vicinity of the coupling link.

Visual inspection showed that the tube retainer ring for V-104 had worked loose due to shock and vibration and had fallen onto the tube in such a way as to short-circuit it. This opened the main fuse F-303 to the high voltage power supply, thus putting the transmitter out of operation. Repaired the trouble by replacing the tube retainer ring and securing it in position.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****TUNING PROCEDURE FOR TDT EQUIPMENTS**

Due to the fact that minimum plate current and maximum output do not occur when loading this transmitter, the following procedure should be used to load the type 704A antenna to this transmitter:

(1) Turn antenna coupling link in as nearly a vertical position as possible, and turn antenna tuning condenser to maximum capacity.

(2) Tune transmitter in usual manner for resonance.

(3) Tune antenna tuning condenser to maximum load. If necessary, move link closer to final tank coil for proper loading. Do not change setting of final tuning after it has been tuned to resonance without load.

(4) Recheck all tuning adjustments but the final for maximum output.

ORIGINAL**TDT:1**

TDZ STOWAGE OF DIAL CRANK

Local activities, that find stowing the TDZ Dial Crank a problem, will appreciate the simple holder suggested by Mr. Ralph H. Hitchcock of the Boston Naval Shipyard.

Two phosphor-bronze fuse clips (ferrule contact type) G17-C-11200 or equivalent should be attached in a convenient place on the side of the transmitter cabinet with 6-32 screws. The two clips should be spaced approximately 180 degrees apart so that the circular portion of the dial crank is firmly gripped on each side.

TDZ INTERFERENCE FILTER

Filter F-141/U and filter box CY-1856/U have been procured to reduce the interference feeding back from the TDZ (radio transmitter) into the ship's 440-volt, a-c power circuits. The filter, filter box, and parts may be obtained through normal supply channels. Installation information and a material list are shown in figure 1. The filter should be firmly mounted near the transmitter and connected in the existing-power cables. No field change will be issued.

TDZ TUNING PROCEDURE

Improper TDZ transmitter operation is a prime contributor to the unsatisfactory condition as well as the short

tube life reported for the 2C39. Tuning of this equipment must be carefully done. An improved tuning method for this equipment is shown below. This method should be followed closely in order to reduce damaging transient surges, improve channel selection and maintain optimum output on all channels.

WARNING

IMPROPER TUNING WILL CAUSE DAMAGE
—INSTANTANEOUS OVERLOADS RUIN
THIRD TRIPLER AND POWER TUBES

1--Place the remote local switch, in the LOCAL position.

2--Insert correct crystals and fill in the two cards on front panel.

3--Place the automatic tuning on-off switch (inside door on left side of middle drawer), in the ON position.

4--Place the emergency operate-stop switch, in the OPERATE position.

5--Place the tune operate switch, in the TUNE position.

Adjustments for Tune Position

6--Depress start button of start-stop switch. Power on indicator I101 should light in approximately 60 seconds.

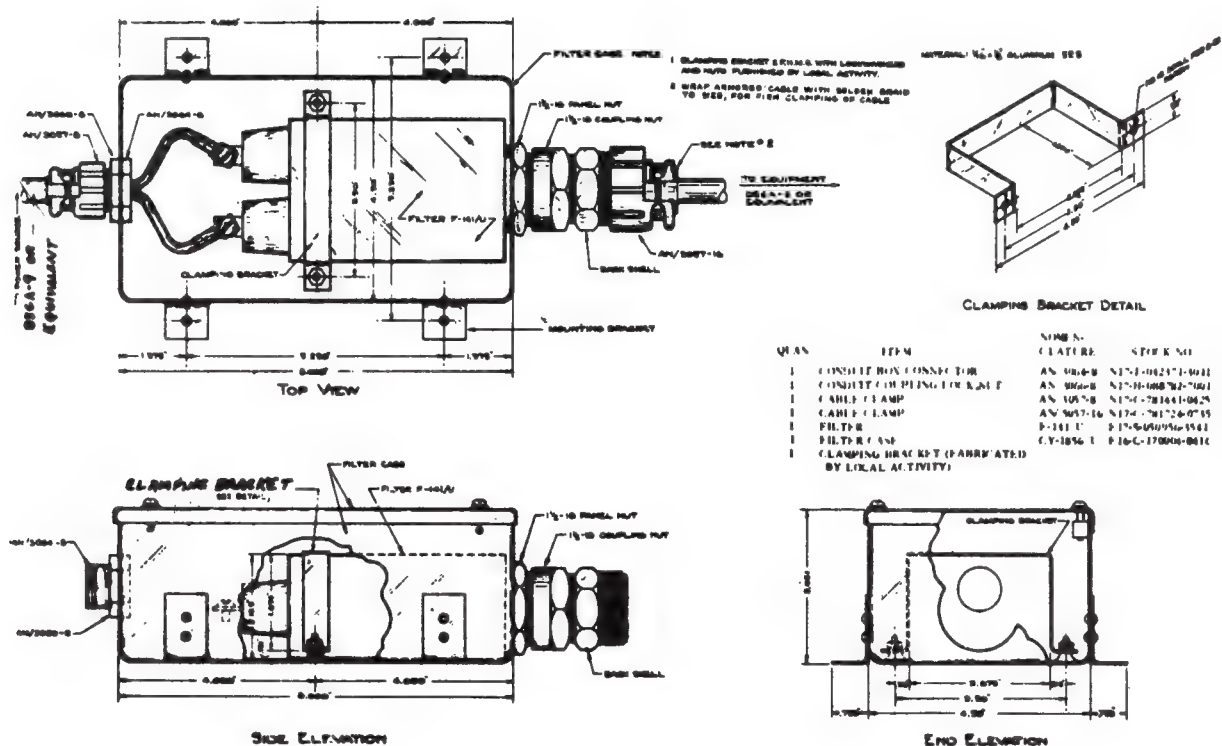


Figure 1

Allow 10 minutes for warm-up when equipment has not been used for several days.

7--Place the tuning indicator toggle switch, in the ON position.

8--Turn all dial (B through L) locking bars clockwise with fingers until tight.

9--Dial the channel to be tuned with the channel selector dial. The tuning system should operate approximately 30 seconds before tuning is completed.

10--Observe the local channel indicator for correct indication of the selected channel. Control A and the channel indicator should always read the same.

11--Loosen all dial (B through L) locking bars by turning bars one-fourth turn counterclockwise.

12--Set all dials except G, H, K, L, to approximate position for frequency being tuned. See figure 3-26 (pp. 3 to 37) of Instruction Book. Set controls G, H, K, L, to dial position of O. If Instruction Book not available set all controls to O.

13--Check crystal oven for heating by placing fingers on oven (mounted behind door in middle drawer). If the oven does not get warm, a technician should check heating system.

14--When tuning depress carrier switch momentarily to obtain meter readings. Do not place switch in LOCK position.

15--Set grid meter switch to DBLR position. Tune dial B for maximum grid current (15 to 18 ma). ALWAYS SELECT THE FIRST POINT OF RESONANCE WHEN ROTATING DIALS CLOCKWISE. For those dials which are preset, first turn dials counterclockwise (B and C 1/2 revolution and all others 2 revolutions) and then clockwise to resonance.

NOTE.--Controls B and C are very sensitive and require extreme care in adjustment. Resonant points should be approached very slowly with clockwise rotation of the dials.

16--Set grid meter switch to second trip position. Tune dial C for maximum grid current (18 to 20 ma).

NEVER PERMIT THIRD TRIPLER AND PA GRID CURRENT TOTALS TO EXCEED 35 MA. NEVER PERMIT THIRD TRIPLER AND PA CATHODE CURRENT TOTALS TO EXCEED 100 MA

17--Set grid and cathode meter switches to third tripler total position. Tune dials D and E for maximum grid current (approximately 20 ma).

18--Tune control F for dip in cathode current.

19--Set grid and cathode meter switches to PA total position. Manipulate controls G and H until grid meter reading is obtained. Retune control F for peak PA grid current not to exceed 35 ma. Reduce third tripler coupling by dials G and H to maintain current below 35 ma.

20--Tune controls I and J for peak grid current not to exceed 35 ma. (Note PA cathode current. If excessive reduce coupling by G and H).

21--Tune controls K and L for maximum indication on tuning indicator or ME-11/U wattmeter.

22--Retune dials F, I, and J for peak grid current not to exceed 35 ma.

23--Retune controls K and L for maximum indication on the tuning indicator or ME-11/U wattmeter.

24--Retune dials F, I, and J for peak grid current not to exceed 35 ma.

Note.--The third tripler and PA grid and cathode currents should be balanced. The grid currents should balance within approximately 5 ma. cathode currents should balance within approximately 15 ma. It is usually possible to improve balance by manipulation of controls, F, G, H, I, and J.

No definite procedure can be followed to maintain balance of these currents which necessitates a trial-and-error method. If balance is not obtained, consult technician regarding previous setting at midband frequency of third tripler and PA balancing resistors. Inability to obtain balance within above limits by these methods indicates a possible inferior tube.

25--Place tune-operate switch on OPERATE.

Adjustments for Operate Position

NEVER PERMIT THIRD TRIPLER AND PA GRID CURRENT TOTALS TO EXCEED 50 MA. NEVER PERMIT THIRD TRIPLER AND PA CATHODE CURRENT TOTALS TO EXCEED 150 MA

26--Make quick check of third tripler and PA total grid currents and total cathode currents. If excessive, place equipment in TUNE position and reduce drive to third tripler by control D. Place equipment in OPERATE position and again make quick check of these currents.

27--Place meter switches to total PA grid and cathode current positions. Tune dials G and H for PA peak grid current not exceeding 50 ma while maintaining total cathode current below 150 ma.

28--Tune dials K and L for maximum indication on tuning indicator or wattmeter and dials J, I, and F for peak grid current of 50 ma. Maintain total grid current below this value and total cathode current below 150 ma with dial D until no further increase can be made on tuning indicator or wattmeter with dials K and L.

29--If necessary, obtain balance as outlined in note under step 24.

30--An output of approximately 20 watts with tubes operating within the limits specified is considered satisfactory although up to 35 watts may be obtained at certain frequencies.

31--Place equipment in TUNE position and log all meter readings. Make certain that all final dial settings have been approached in the clockwise direction. Lock all dials by turning all locking bars with fingers until tight. Care should be taken to prevent dial movement while locking. Prevent binding of locking bar with stop nubs

on metal plate behind bar by rotating stop nubs clockwise with finger to provide sufficient clearance. After locking, check dials by grasping them firmly and turning them smartly, first counterclockwise, then clockwise against their stops.

32--Log all dial settings.

33--Dial another channel. Redial channel tuned and with equipment in TUNE position, check to see that meter readings and dial settings are same as logged in steps 31 and 32. If not the same, controls B and C are usually responsible. Try to obtain proper meter readings by retouching these controls and redialing. Consult technician if normal readings are unobtainable.

34--Place equipment in OPERATE position, and determine that third tripler and PA total grid and cathode currents are not exceeded.

TDZ TUNING HINTS

When manually tuning the TDZ transmitter, one should carefully follow the instruction book. However, the following hints which were contained in Atlantic Fleet Letter No. 40L-48 are considered excellent and should prove helpful:

1--Turn locking bars in center of dials counterclockwise 1/4 turn and tune up the transmitter properly on one channel with low power, disregarding the autotune.

2--Log the dial settings when proper operation is obtained.

3--Set each autotune for this channel by the following procedure (items 3-11): Back the dial counterclockwise at least one-third of the way to zero. Note that this is seven complete turns of the multitune dials.

4--Bring the dial clockwise to the logged figure, approaching the final setting slowly so as not to overpass it.

5--Turn the dial counterclockwise one or two divisions so that it may be held with one hand without going beyond the logged setting, while the locking bar is tightened with the other hand.

6--Proceed similarly with the other dials.

7--Check all dials to see that their autotunes are locked.

8--Dial some other channel.

9--Redial the channel just tuned.

10--Compare each dial setting with the logged setting and readjust any that has come up incorrectly.

11--Check the transmitter operation on low power to see that the logged settings, when tuned by the autotune, result in satisfactory operation.

There is one other point which, although brought out in the instruction book, is considered to be sufficiently important to print again. While manually tuning the TDZ transmitter, the operator must be sure that the "tune-operate" switch is in the "tune" position and the PA grid current does not exceed 40 ma.

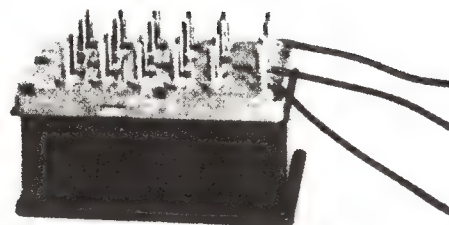


FIGURE 1.—Bottom view of crystal oven showing test leads connected to heater pins W, Y, and Z

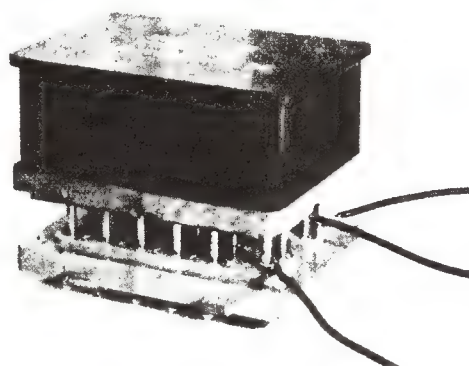


FIGURE 2.—Crystal oven and oven socket showing test leads connected

In "operate" position, the total PA plate current should not exceed 100 ma. (This is determined by subtracting the total PA grid current from total PA cathode current.)

The Bureau is now supplying dial cranks as Field Change No. 5-TDZ for the purpose of manually tuning and setting up channels on the TDZ. It will be found that the cranks will help considerably in making adjustments.

ADDITIONAL INFORMATION ON CRYSTAL OVENS FOR RDZ, MAR, AND TDZ RADIO EQUIPMENTS

After a lapse of several months, shipment of crystal ovens for RDZ, MAR, and TDZ radio equipments was resumed in July 1947. Additional improvements have been incorporated in these new ovens. These improvements include changes in the thermostats and heater windings to make operation more positive with less work on the part of the thermostat (that is to say: maintain an even temperature with fewer cycles of operation). The new ovens, supplied under contracts NXsr-86362, NObsy-39267, and

COMMUNICATIONS

NObsr-42053, will have the type number CFT-40148A embossed on the cover as well as having the two internal screws color coded for easy identification. See Figures 1 and 2.

A complete résumé of the ovens, color coded by the month of manufacture, is given in the following table (Note: Ovens manufactured from December 1945, up through November 1946, are designated as Navy type CFT-40148, and those from July, 1947, up through July 1948, are designated as Navy type CFT-40148A. This may be used for identification if color-code duplication occurs.

Month of manufacture	Color-Code	
	Screw nearer heater pins	Screw away from pins
Dec. 1945	Red	Blue.
Jan. 1946	Red	Yellow.
Feb. 1946	Red	Green.
Mar. 1946	Blue	Yellow.
Apr. 1946	Blue	Blue.
May 1946	Brown	Brown.
June 1946	Red	Red.
July 1946	White	White.
Aug. 1946	Black	Black.
Sept. 1946	Orange	Orange.
Oct. 1946	Yellow	Yellow.
Nov. 1946	Gray	Gray.
Dec. 1946 through June 1947-	None shipped.	
July 1947	Green	White.
Aug. 1947	Red	White.
Sept. 1947	Brown	White.
Oct. 1947	Black	Black.
Nov. 1947	Yellow	White.
Dec. 1947	Blue	White.
Jan. 1948	None manufactured.	
Feb. 1948	Green	Black.
Mar. 1948	Red	Black.
Apr. 1948	Brown	Black.
May 1948	Yellow	Black.
June 1948	Blue	Black.
July 1948	Green	Red.

When type CFT-40148 ovens are utilized, it should be determined that they are heating properly. After a few minutes of operation, the ovens should feel very hot to the hand. If they do not warm up, the thermostat can be checked by the following simple method: First the oven is removed and short leads are connected to the heater pins W, Y, and Z. The oven is then replaced. Either two 12-volt pilot lamps or voltmeters should be connected as shown in the accompanying diagram of Figure 3. The equipment is then turned on. The lamp or voltmeter across W and Z (the low side) should go out or register zero after a few minutes of warm-up. The lamp or voltmeter across Y and Z (high side) should continue to register for a few

TDZ:4

NAVSHIPS

900.000.1

SERVICE NOTES

minutes after the low side has "cut off", and then should begin to "cycle", indicating that the thermostat is maintaining the oven at an even temperature.

Activities should utilize all of the old-type ovens before resorting to the use of the new ones. It is requested that the defective ovens should not be surveyed, but instead returned to the Supply Officer in Command, NSD, Clearfield, Utah, Attn: Electronics Supply Officer, and marked "For Disposition by Bureau of Ships".

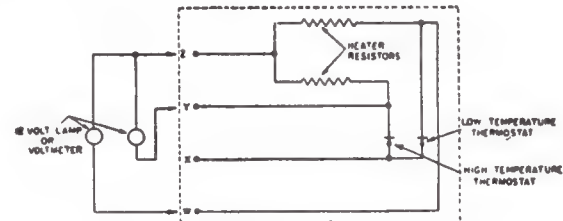


FIGURE 3.--Simplified heater circuit of crystal oven

CORRECT CRYSTALS FOR USE WITH TDZ EQUIPMENTS

TDZ equipments, serial 1 through 100, are designed for use with crystals, Navy type-40161. Equipments, serial 101 and thereafter are designed for use with crystals, Navy type-40162. Due to possible inactivity of crystals and off-frequency operation, field activities are cautioned not to use crystals and equipments interchangeably.

TDZ AND RDZ--CRYSTAL OVEN FAILURE

A frequent but easily overlooked cause of a TDZ and RDZ failure is a cold crystal oven. Naturally, when a crystal oven fails, the results show up as weak or lost signals. Technicians should check crystal ovens daily to prevent such failures or locate them as soon as possible.

CRYSTAL OVENS FOR TDZ RADIO EQUIPMENT

See the article entitled "Crystal Ovens for RDZ, MAR and TDZ radio equipments", in RDZ series.

OBTAINING CRYSTALS

See the article entitled "Obtaining Crystals for MAR, RDR, RDZ, and RDZ", in MAR series.

TYPE 2C39 TUBES IN TDZ AND MAR RADIO EQUIPMENT

The Bureau has received information that one cause of the failure of Type 2C39 tubes in the model TDZ and MAR radio equipments is inoperation of the blower motors

ORIGINAL

TDZ equipment furnishes a very poor visual figure 1.

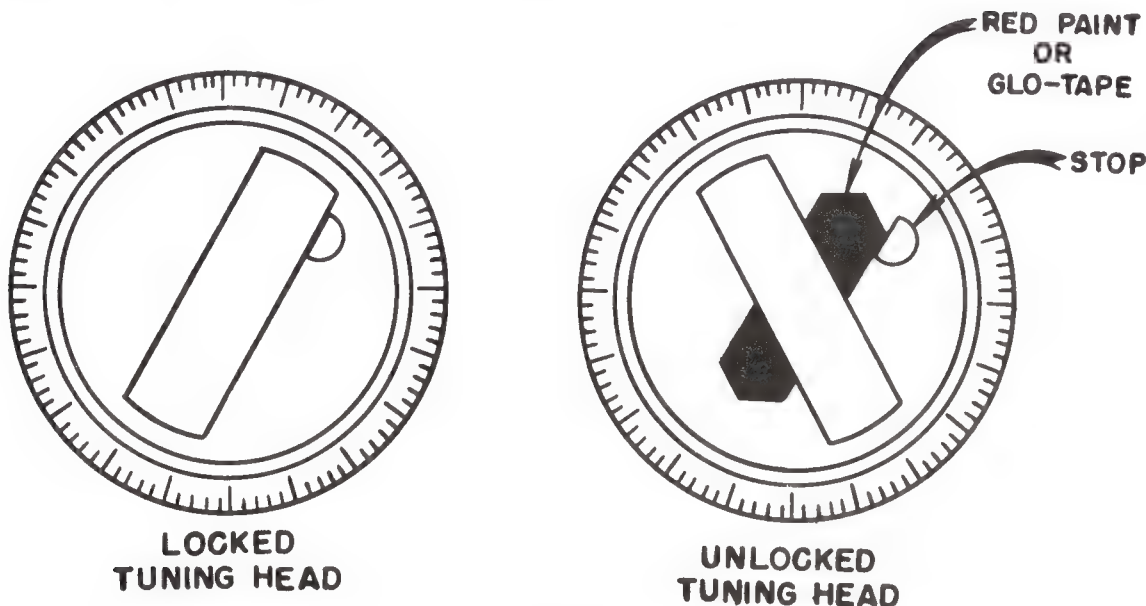


FIGURE 1.

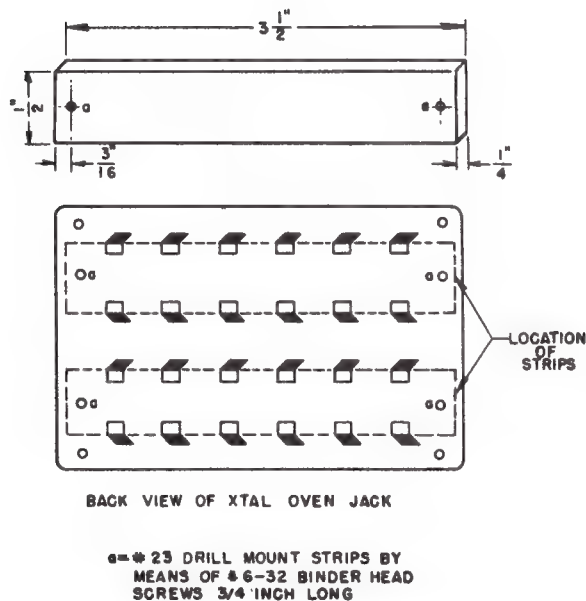


FIGURE 2.

B-101 and B-102. Failure of these motors to operate may result from defective bearings or from reversed motor connections. When tube failure occurs, these blower motors should be inspected immediately and the necessary corrections made. Moreover, periodic preventive inspections should be carried out in advance of any failure.

Although correspondence and verbal reports indicate that these tubes are failing in relatively large numbers, the Bureau has received very few Type 2C39 failure reports. This is unfortunate because, in order to carry out an effective maintenance program, it is essential that all failures of this nature be reported at once. All reports should include all possible information regarding the failure, such as condition of the blower motors, tube voltage, and operating frequency.

ADJUSTMENT FOR PROPER FILAMENT VOLTAGE OF 2C39 TUBES

The table for 2C39 tube filament voltage adjustment shown in figure 3-22 of the TDZ Instruction Book was predicated upon average performance of equipment components. These values may vary slightly due to tolerances permitted in the component design. Therefore, prior to final adjustment of tapswitch S-113, actual voltage measurements should be taken and the tapswitch set to provide as near the required 6.3 volts as possible, regardless of settings shown in figure 3-22.

FAILURE OF TDZ ANTENNA TRANSFER SWITCHES

The Bureau has frequently been advised of failure of the cable connectors on the TDZ antenna transfer switch. These connectors have a symbol number of J-105 and J-106 in the TDZ Technical Manual. The Navy Type number is 491212.

All electronic officers should make sure their stock of spare connectors is adequate.

LOCKING INDICATOR FOR DIALING MECHANISM OF TDZ

Radio Transmitting Equipment TDZ employs 11 autotune mechanisms by means of which ten channels may be manually preset for automatic tuning. The entire 10 channels must be retuned if these autotune mechanisms are not locked prior to switching channels automatically.

The Bureau has been informed that the TDZ equipment furnishes a very poor visual indication of whether a tuning-dial lock is in the locked position.

It has been suggested that a red indicator be placed on the tuning-dial (see fig. 1) to show by a quick glance at the dials if they are locked. The Bureau concurs in this suggestion. It is recommended that red paint or Glo-Tape be procured locally and used to give the necessary indication as shown in figure 1.

OVEN JACK FAILURE

The Bureau has received reports of oven jack failures in the TDZ equipment due to pin socket contacts being forced from their mounting holes when the crystal oven is pushed into place.

The use of back-up strips of bakelite to prevent dislodging the contacts has been proposed. (See fig. 2.) A suitable low loss bakelite may be used; or better, use two strips $\frac{1}{2}$ inch x $3\frac{1}{2}$ inch each of $\frac{1}{4}$ inch silicone resin glass cloth laminate. Attach these strips to the back of the oven jack with No. 6-32 binder head screws as shown in the sketch. No field change will be initiated by the Bureau for this suggestion.

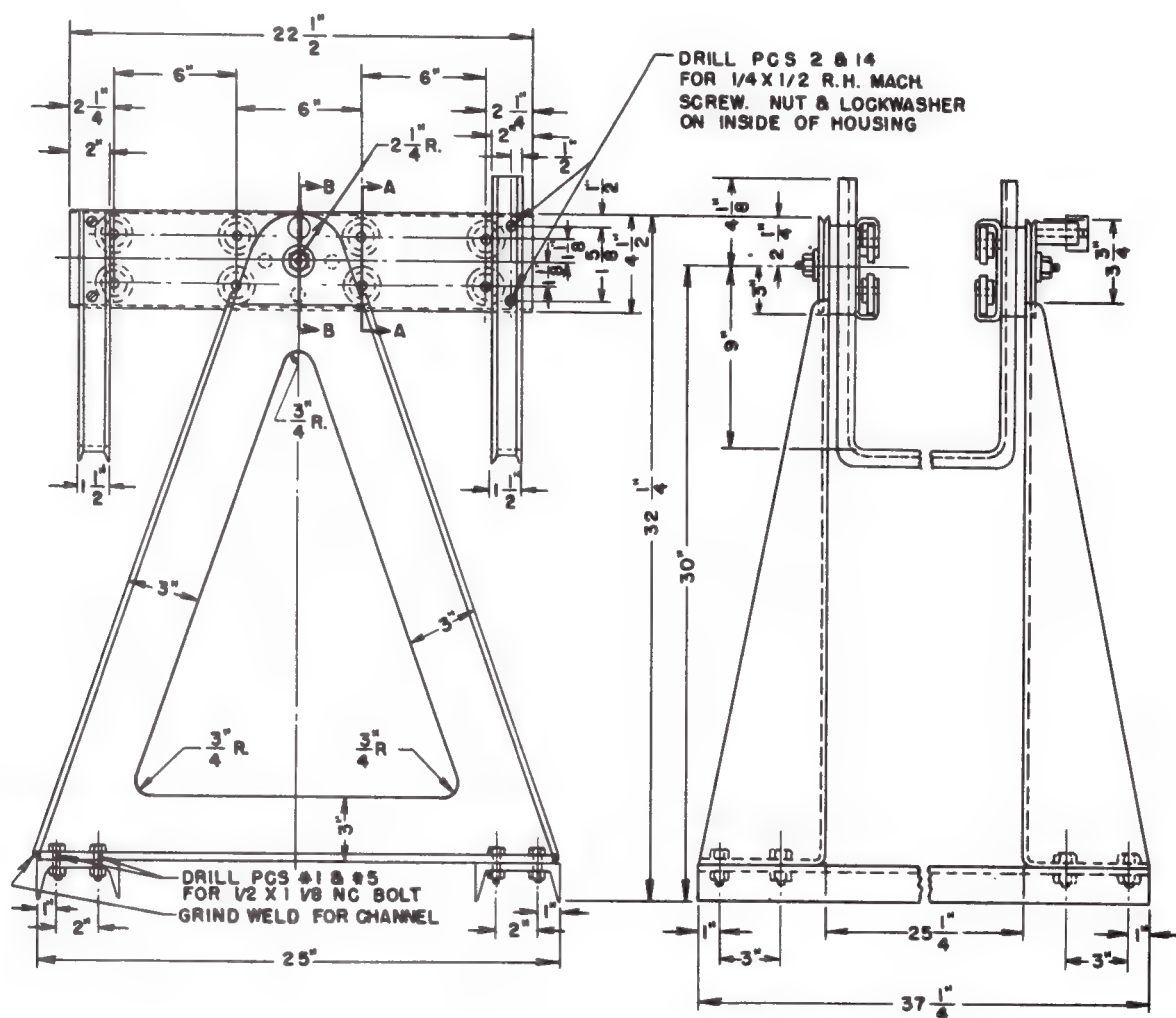


FIGURE 1. Construction Details For TDZ Test Rack.

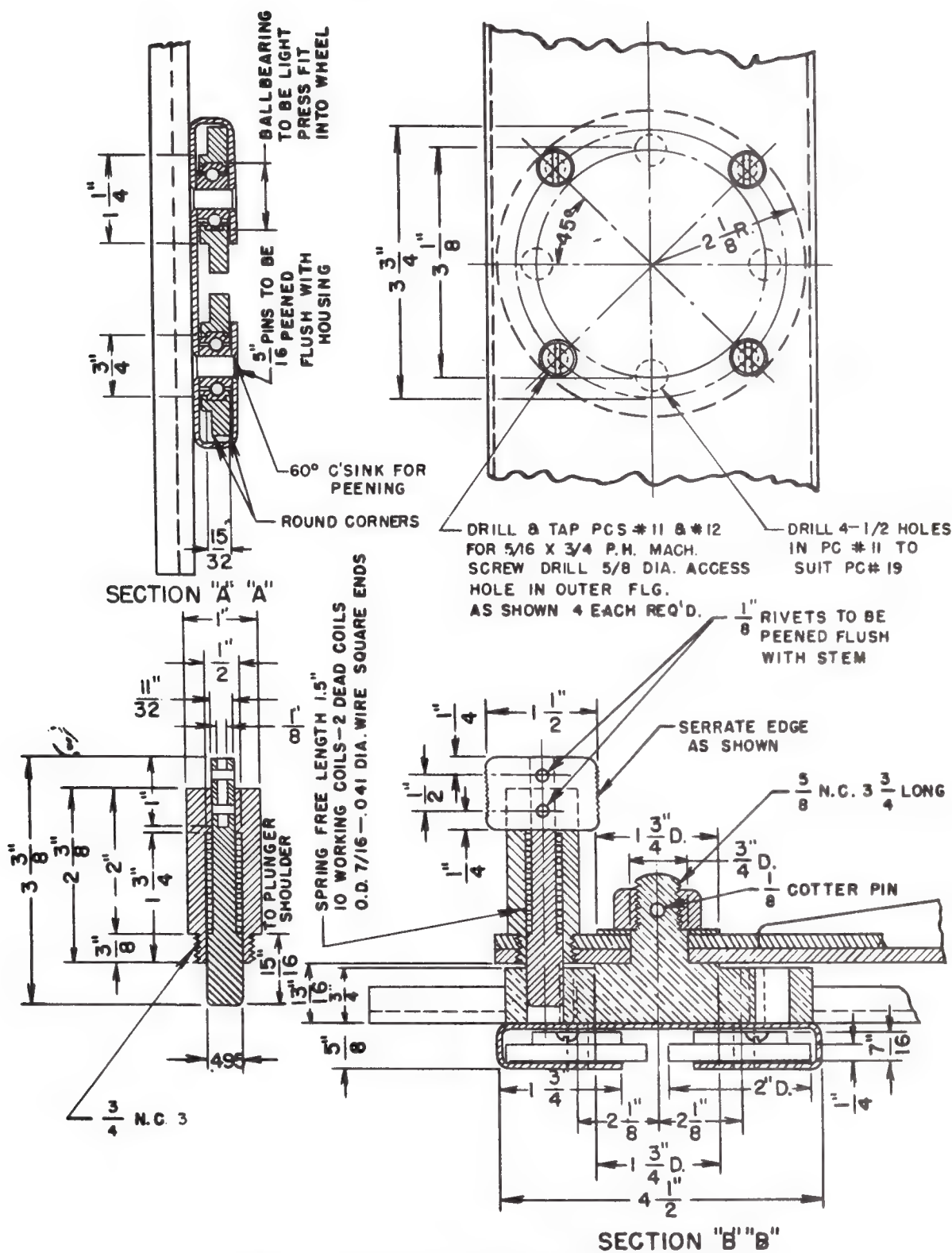


FIGURE 2. Construction Details For TDZ Test Rack (Cont.)

FSN's FOR AUTOTUNE DIALS

A suggestion has been instrumental in the assignment of stock numbers to the autotune-mechanism tuning dials and crystal-selector dial of the TDZ Equipment. Prior to this action, it was necessary to stock complete autotunes in order to provide these dials for replacement purposes. The autotune dials (used with E-102 through E-113 inclusive) have been assigned stock number **N5355-546-4682**; and the dial for the crystal-selector (used with E-101), stock number **N5355-233-3601**. This makes it possible to order and stock these dials as individual items. Therefore, stocking and ordering complete units for the purpose of obtaining replacement dials should be discontinued immediately.

Symbols 0-292 (autotune dial) and 0-293 (crystal selector dial) have also been assigned to designate these two items.

TDZ SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered

Improper operation.

Channel not tuning properly on autotone or dials stopping at any random setting.

No audio for m-c-w operation.

Low emission.

Binding of autotone mechanism.

Cause and Remedy

First-always check dial settings against logged settings.

(1) Bad contact between multiple plug and connector.

Examine and clean. (2) Slipping clutch caused by excessive lubricant. Disassemble and clean. (3) Pawl not falling in place on autotone cam drum. Remove burr from edge of cam.

Replace 6SN7 audio oscillator tube.

Check 2C39 third tripler and power amplifier tubes.

Shaft of C-158 for third tripler broken. Repair or replace.

TDZ TROUBLE SHOOTING NOTES

Type of failure	Symptom	Cause
Tubes	Low output or no output. No modulation or poor modulation.	V107-V120; most likely, V115-V119. V101-V102, V110.
Tuning	Low output or no output. Tube failure. Failure of R122-R124.	Tuning to harmonic. Improper locking of heads. Faulty tuning.
Autotune system	Controls not stopping at preset positions. Slipping, unable to lock, no rotation. Master or slave Autotune system inoperative.	Worm gear not meshed. Limit-switch circuit broken. Clutch too tight. Improper synchronization. Lack of lubrication. Set screws not tightened.
Drawer contacts	Starting light out. No channel indication. Unable to key. No power output.	Drawer not centered, tightened. Dirty or broken contacts.
Control relays	Wrong channel selected. Wrong channel indication. Start button inoperative. Unable to key. High antenna current. Overload reset inoperative.	S114 worn or making poor contact. K106, M103, K108, or K106 antenna relay K110.
Antenna, cable, and couplings.	Weak or no power output	Damaged antenna. Open or loose couplings. Open transmission line. Short in transmission line due to moisture or corrosion.
Poor preventive maintenance. Components	Faulty and inefficient operation. Equipment dirty. No field changes completed. Smoke or odor. Hum or carrier. Unable to balance tubes. Phone inoperative.	Lack of training. Improper supervision: C118, C119, C120B, or C104, R172-R174 burned by improper tuning, Winding 1-2 of T101.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS**

Meters	Indicator inoperative. Abnormally high reading.	Open meter coil M103. Defective V119 Antenna relay.
Tube sockets	Low or no output	X115-119 easily damaged by rough handling or by improper removal and insertion of tubes. Heater and cathode diameters vary for various manufacturers.
Crystal oven	Cold oven. Improper heating	Short or open thermostat. Oven loose in socket. T107, winding 9-10.
Power supply	No primary power. Blower motors inoperative. Microphone voltage failure. No 115-volt power. No high voltage.	Drawer contacts. 12-volt supply. Defective rectifier. F104, F105, F103, T107. V107-V110. T104, winding 3-11.
Miscellaneous	Vibration. Harmonic interference	Loose drawers or shock mounts. R-f filter not connected. Tube clamps not tightened.

FIELD SERVICE NOTE ON THE TEB TRANSMITTER

The EFSG has reported the following field service note relative to the TEB transmitter at the Naval Radio Station, Manila.

On TEB transmitter at this station showed 6400 volts on the main power supply rectifiers. Visual inspection of the rectifier tubes, V-25 and V-30, showed that there was no internal flashover under load. Renewal of these tubes made no change in operation. Removal of the plate connection on V-29 permitted V-30 to flash and likewise the removal of the plate connection on V-26 permitted V-25 to flash. It was apparent that a high-resistance connection existed some place in this circuit, either primary or secondary. This high resistance was located in the contacts of RL-5 and RL-6. The contacts were badly pitted and the movable contact pigtail jumpers were badly burnt due to the poor condition of the contacts. These contacts were cleaned and readjusted and the pigtail jumpers renewed with appropriate Belden braid. The TEB returned to satisfactory operation.

REDUCED FILAMENT VOLTAGE ON TYPE 889RA ELECTRON TUBES IN TEB EQUIPMENT

The average life in hours of the type 889RA electron tube has been increased by over 95 percent at the Naval Communication Station, Annapolis, Md., by decreasing the applied filament voltage from 11 volts to 10 volts. No reduction in power output or other abnormalities of operation result from this reduction. In view of the economy resulting from increased tube life, the Bureau recommends that this type of tube be operated with a filament voltage of 10 volts, wherever suitable voltage regulation is maintained.

REPLACEMENT OF IPA BAND CHANGE SWITCH (S501)

The original IPA band change switches have proven unsatisfactory in operation in TEB transmitters. The Bureau has procured on Contract NObsr-49055 newly designed switches which have been delivered to activities where TEB transmitters are installed. Current inventory data was used to determine the number of switches to be shipped to activities using this transmitter. If additional switches are required, they will be supplied by the various stocking points of the Electronic Supply System under stock number N5930-319-2227.

SHAPER CONTROL CIRCUIT

The following report of connection errors in the Radio Transmitter TEB shaper control circuit has been received from the Electronics Officer, U. S. Navy Radio Station (T), Barrigada, Guam. The troubles cited and the corrective measures indicated have been checked by cognizant technical codes of the Bureau of Ships.

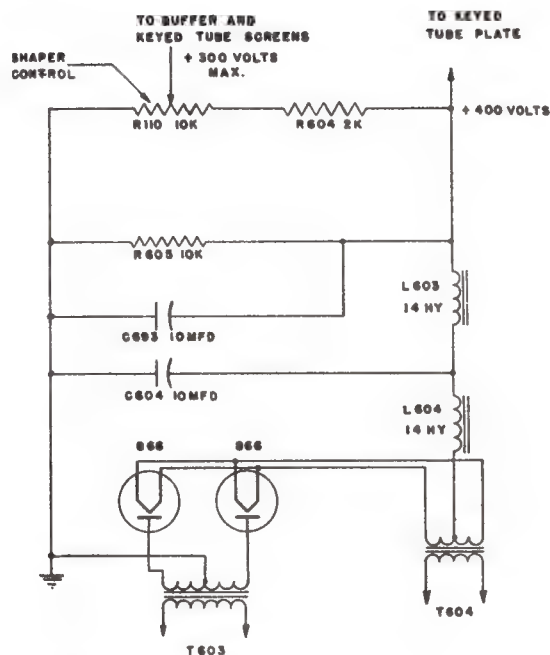


FIGURE 1.--Model TEB Shaper Control Schematic Diagram Simplified

Note.--The diagram preceding shows the circuit after resistors have been installed in accordance with the manufacturer's diagram.

"1. It was noted that r.-f. excitation in the IPA stage in the TEB Radio Transmitters installed at this activity, was much lower than the value called for in the manufacturer's instruction book.

"2. Investigation disclosed the following condition existing in all thirteen (13) presently installed TEB transmitters;

a. It was discovered that R-604 (2,000 ohms) and R-605 (10,000 ohms), both located in the keyed stage power supply, had been interchanged.

b. This placed R-605 (10,00 ohms) in series with R-110 (10,000 ohms) and the entire combination in parallel with R-604 (2,000 ohms).

c. The resulting being that the shaper control, R-110, could only pick off a maximum of 200 volts for the screen grid supply of the buffer tube and the keyed tube, instead of the otherwise nominal value of approximately 330 volts.

d. With this circuit and the shaper control (R-110) set on position No. 3, only 5 to 10 ma. of grid current could be drawn by the Intermediate power amplifier state instead of the required 30 to 50 ma. This greatly decreased the transmitter output.

"3. When the circuit was connected up properly in accordance with the manufacturer's schematic diagram, IPA grid current of 30 to 50 ma. was obtained.

"4. Inasmuch as the schematic diagram was correct, but the resistor clips in question were incorrectly labeled, it is felt certain that the error occurred during the assembly of the transmitter at the factory ..."

COMMUNICATIONS**NAYSHIPS****900,000.1****SERVICE NOTES**

The shaper circuit in question is shown in figure 1.

FAILURE OF THE TEB TIME INTERLOCK MECHANISM

The time interlock mechanism of relay K-801 incorporated in the TEB transmitter has on occasion failed to short out filter condensers C 612 and C 613 when the high

voltage was off at the 7 KV rectifier. To prevent a serious hazard due to such a failure, it is stressed that these mechanisms be given periodic maintenance inspections to insure that all mechanical parts are clean and free acting. Relay K-1126 of TEC transmitters should be similarly checked.

FAILURE OF BLOWER MOTOR

Failures of the ventilating system in Radio-Transmitting Equipment, TED Series, have been traced to excessive wear of the blower-motor brushes. The brushes supplied with the first procurements of these equipments proved to be too soft, resulting in rapid wear. Although the instruction books call for weekly checks for adequate brush length, continuous operation of the equipment in some cases has resulted in failures in spite of adherence to maintenance schedules.

Equipments containing black motors, manufactured by Rotron Mfg. Co. (Ser. No. 300 and above on TED-1), were supplied with brushes of harder material. Life tests on these brushes have shown that at least 1,000 hours use can be expected. Gray motors, also manufactured by Rotron and used in all TED and low serial number TED-1 equipments, had brushes of soft material.

Replacement brushes of the hard material are being distributed to supply points by the Electronics Supply Office. The new brushes bear the same stock number (SNSN No. N17-B-86231-1301) as the old since they are entirely interchangeable. Stock on hand should be used before requisitioning the new brushes.

JAMMING PA TUNING DIAL

The power-amplifier chassis of the TED equipment has its top cover secured by six, size 4-40, fh screws; five of which normally are 3/8-inch long, and one is 1/4-inch long. The short screw must be used in the front-center hole directly above the tuning dial.

Mr. S. E. Lanotte of Shop 67, New York Naval Shipyard, through a beneficial suggestion has brought to light a jamming condition of this dial due to personnel inadvertently placing a 3/8-inch long screw in this location when re-installing the cover after routine maintenance. A review of this condition had developed that this human factor can be eliminated by replacing all six screws with size 4/40 fh screws, 5/16-inch long. Local activities should make this substitution in all TED equipments during routine maintenance. No field change will be initiated by the Bureau.

CARBON DUST

Reports have reached the Bureau that carbon dust from the blower-motor brushes in Radio-Transmitting Equipment TED is fouling the rf unit. Apparently the carbon dust escapes through the small space around the motor-power cord. This can be prevented by sealing this space with DC-4 (Dow Corning silicone compound), NS1-C-5194-1500). The cord should be resealed after the motor is removed for servicing during routine maintenance.

ELIMINATION OF SPURIOUS OSCILLATIONS IN TED SERIES

Recent investigations have disclosed that, under certain conditions, a spurious audio oscillation may appear

on the rf carrier of Radio Transmitting Equipment TED Series and cause impairment of voice modulation. These spurious oscillations are caused by rf feedback to the first audio-amplifier stage in the modulator. The extent of these oscillations depends largely upon the placement of interconnecting cables. Further investigations are expected to determine a satisfactory corrective measure. In the meantime, if such oscillations occur in the TED equipment, operate the equipment with the CLIP FILT Switch (S-103) and the EXP (S-104) OFF and the AVC Switch (S-102) ON. Under this condition, the feedback level is not sufficient to maintain oscillations.

HUM

The Bureau has received reports of high-frequency hum in the output of the TED Series equipments, resulting from imperfect grounding of the blower-motor shaft. This shaft is grounded by a spring contact which in time may become worn or lose tension, allowing the rotor to electrically float above ground. This may cause interference including an 8000-cycle hum superimposed on the signal when phone or MCW operation is used. Where such a condition is encountered, the spring contact should be removed and bent slightly to restore good contact with the motor shaft.

TED AIR VENTS

Plastic air vents, which guide the air stream across the p-a tube, cooling fins in the TED Series equipment, will warp or melt if the blower-motor fails and the equipment is kept in operation. Since air-vent spares were not originally supplied with TED, TED-1, and TED-2, it has been necessary to fabricate replacement vents locally. Vents are included in equipment spares for TED-3 to TED-6 inclusive and are now a stock item for all TED Series equipments.

Mr. Oscar Berenberg of the New York Naval Shipyard has suggested that Teflon be used in local fabrication of air vents because machining and heat-tolerance characteristics are superior to those of the original polystyrene vents. This suggestion has merit and may be used in an emergency when replacement vents are not available.

Damage to air vents and other components of the TED Series equipments resulting from blower failure should be virtually eliminated by a forthcoming Field Change (1-TED). The kit, which will be available about 1 July 1955, includes a protective thermal switch to shut down the equipment in case the blower fails.

TED SAFETY HAZARD

Mr. Edward F. Carmanica, Boston Naval Shipyard, in a beneficial suggestion, indicated a safety hazard in Radio Transmitting Equipment TED. The metal case of capacitors C-130 and C-187, located underneath the power chassis, is 600 volts above ground. Since the metal case

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

of this type capacitor is normally expected to be at ground potential, this is a particularly dangerous condition.

BUSHIPS will initiate a field change providing decals to mark these capacitors in red: "DANGER, CAPACITOR CASE 600 VOLTS TO GROUND". In the meantime, Electronics Technicians are cautioned to avoid contact with these capacitors when servicing the TED (See BUSHIPS Manual, Chapter 67, Part 12 Safety Precautions.)

TED CLAMP TO SUPPORT POWER CABLE

Mr. Julian Kupchynski and Mr. Salvatore Uvino, of the New York Naval Shipyard, have suggested that an additional cable clamp be installed in the cabinet of the TED Series (radio transmitter) equipment to prevent the power cable from sagging with subsequent damage as the cable becomes worn from sharp edges of the set.

A rubber-lined cable clamp should be used, such as an Adel No. 12 (round type) or equivalent. This clamp should be located about midway between the rear of the cabinet and the forward clamp. It should be secured by means of a No. 8-32 oval-head screw, nut, and lockwasher. Use a No. 18 drill for drilling the mounting hole. A forthcoming Field Change will correct this deficiency and will include other modifications to the TED Series equipment.

TUBE TYPE 4X250B VERSUS 4X150A IN TED SERIES AND AN/GRC-27

The substitution of electron tube Type 4X250B in sockets of the TED Series and AN/GRC-27 requiring the use of tube Type 4X150A is neither authorized nor recommended. It should be noted that both tubes 4X150A and 4X250B are identical except for the types of seals used; 4X150A (glass to metal seal) and 4X250B (ceramic to metal seal). Type 4X150A tubes procured prior to 15 April 1959 had external anode fins or radiators soldered on, while those of Type 4X250B are brazed. This condition allowed the 4X250B to operate at a higher-plate dissipation and temperature than the 4X150A. However, the 4X150A (with a brazed radiator), now being procured to the latest military specification, MIL-E-1/160G is, comparable to the 4X250B, and is capable of operation at 250 watts of plate dissipation with lower-plate temperature and less cooling air than earlier 4X150A tubes.

Tube substitutions are evidenced by the demand being made on the supply system for the 4X250B, and tube failure reports listing the TED Series or AN/GRC-27 as applications. It is believed such substitutions are being made solely on the basis of the tube's past performance problem and the assumption that the use of the 4X250B will increase equipment reliability. Such assumptions are not based on operating facts. The availability of the 4X250B is, and always has been, very limited, due to the manufacturer's inability to solve the tube-sealing problem (ceramic to metal sealing).

Recent control-comparison tests (conducted under identical conditions by Aeronautical Radio Incorporated

(ARINC) for the Bureau of Ships) to determine the merit of reliability of the 4X150A (with a soldered radiator), 4X150A (with a brazed radiator), and the 4X250B, indicated the following mean time between failure (MTBF): 4X150A (soldered radiator), 2200 hours; 4X150A (brazed radiator), 3000 hours; and 4X250B, 1130 hours.

The results of exhaustive investigations, testing, and analysis by the Naval Material Laboratory, ARINC, and the Air Force, on earlier 4X150A's with soldered radiators, indicate that:

1. The 4X150A will provide satisfactory service when operated within the tube and equipment specification.
2. The 4X150A, as used in the TED-Series equipment is being used beneath its maximum rating, and no advantage is gained by using the 4X250B.
3. The 4X150A, as used in the AN/GRC-27, is being operated near its maximum rating; however, due to the fact that the 4X250B is, for all practical purposes, the same as the 4X150A, no advantages are realized by this substitution.
4. The major causes of unreliability can be attributed to improper maintenance; operation under adverse conditions (such as improper loading, insufficient cooling, improper alignment, or tuning (off resonance)); application of high voltage without filament voltage; and insufficient drive. These conditions will result in reduced life and damage to any power tube.

WIRING ERRORS IN TED TRANSMITTER

It has been reported to the Bureau of Ships by field activities that wiring errors have been discovered in power transformer T104 of the TED Transmitting Equipment.

Examples of such wiring errors are described as follows: (Refer to Figure 7-30 of technical manual NAVSHIPS 91585 or Figure 7-21 technical manual NAVSHIPS 91357).

(1) The white-black wire was connected to terminal 3 instead of terminal 1. The white-red wires to terminals 2 and 4 were reversed. When the jumper was connected between terminals 2 and 3 for 230 volt operation, the 230 volt line was short circuited.

(2) The white-black wire was connected to terminal 3 instead of terminal 1. When jumper was connected between terminals 2 and 3 for 230 volt operation, 230 volts was applied to only one-half of the primary winding.

It is requested that all field activities installing the TED transmitter carefully check the wiring in power transformer T104 for conformance with the wiring diagrams in the technical manuals.

MAINTENANCE OF AIR FILTER SCREENS IN TED SERIES RADIO TRANSMITTING EQUIPMENT

The Bureau of Ships has received reports of failure of the TED series radio transmitting equipment as a result of overheating. The cause of this overheating has been traced to clogged air-filter screens.

Preventive Maintenance Check Charts in Technical Manual NAVSHIPS 91357 and 91585 (A) indicate that these

screens should be cleaned monthly. In some installations such as at shore stations or when a ship is at a yard or dock, the dust content of the air may be high.

In such cases it is recommended that airfilter screens be cleaned weekly. This maintenance schedule applies to all electronic equipment operating under similar conditions.

Use of gasoline or other inflammable solvents or carbon tetrachloride is not permitted for cleaning air filters aboard ship. The approved cleaning material for this purpose is dishwashing compound. Wash the screens thoroughly in a fresh-water solution of this compound, then rinse and dry. Following this, dip the screens in Navy Type 2190T or 3100 lubricating oil and drain for one-half hour to remove excess oil.

TED SERIES, INSTALLATION MOUNTING INSTRUCTIONS FOR SHIPBOARD USE

Installation instructions for the TED, TED-1 and TED-2 radio transmitters as given in NAVSHIPS 91357, 91475 and 91585(A), are not completely clear in regard to the method of mounting these equipments on a bench or shelf. The only approved installation mounting is as follows:

(1) Where the equipment can be mounted within three inches from the front edge of the mounting surface, bolt the cabinet directly to the mounting surface. Do not use the four steel mounting supports supplied with the equipment. The foundation and cabinet drilling layout is shown in Figures 3-6 and 3-14 of NAVSHIPS 91357, and 91475 or 91585(A) respectively.

(2) Where the equipment must be mounted three inches or more back from the front edge of the mounting surface, the four steel mounting supports must be used. These permit the front of the withdrawn chassis to be lowered sufficiently to allow removal of the chassis from the cabinet. Location of the center of the mounting supports is shown in Figures 3-6 and 3-14 as indicated above. These center holes in the cabinet should be 1 inch diameter instead of 5/16-inch to permit use of a socket wrench in securing the mounting bolts. The four holes (9/32-inch diameter) for attaching each mounting support to the cabinet should be spotted from the mounting supports. Never use rubber type shock mounts in the installation of this equipment.

SHORE STATION INSTALLATION AND MAINTENANCE OF TED

The Bureau of Ships has received numerous complaints from shore field activities concerning high failure rates of the TED transmitter. Most of the reports indicate the same type of failures and the recurrence thereof. These are, namely, rapid wear of the brushes, burn-out of the blower motor, and as a result of failure of the blower, the 4X-150 vacuum tubes fail and the polystyrene air vents melt due to excessive heat. The failure of brushes and the pile-up of carbon dust in the motor is the result of

the high rotational speed of the blower motor which must of necessity turn at 8,000 RPM to provide the required 145 cubic feet of air per minute to assure proper cooling.

The Bureau is now investigating the possibility of providing a lower speed motor of the brushless type or an improved long life unit to be installed as a field change to this equipment. As considerable time will elapse before such a replacement is available, the following preventive maintenance schedule should be put into effect to reduce equipment failures:

1. Inspect blower motor brushes once weekly, and replace when worn to one-half inch in length. Disregard statement in the instruction books to replace brushes when worn to one-eighth of an inch.

2. Every 30 days, remove the complete blower motor assembly and disassemble in accordance with the instructions contained in the instruction manual under Corrective Maintenance, Blower Motor. Care should be taken to assure removal of all carbon dust from the bearings, armature, and field assemblies. If the commutator is pitted or scored, it should be cut down to a smooth surface on a lathe and under cutting of the insulation between commutator bars should be accomplished. If the commutator is badly pitted or scored, the complete motor assembly should be replaced.

3. If the air filter screen is allowed to collect a large amount of dirt, the blower motor will not provide enough air to cool the equipment, with consequent failures. The air screen should be inspected weekly and if found to be clogged, service in accordance with preventive maintenance procedures contained in the instruction manual.

WARNING!

Failure to observe the above preventive maintenance procedures may result in equipment failures that can produce serious consequences when this equipment is used on circuits requiring a high degree of dependability, for example, Naval Air Station Air Traffic Control.

4. The polystyrene air vents may be ordered from Electronic Supply Office stock under **N 5820-311-8766** in the event that equipment spares are expended.

SHORE STATION INSTALLATION

Installation of the TED transmitter should be accomplished in accordance with information contained in the instruction book. However, if installation consists of mounting in a CY-597/G rack cabinet or similar rack mount, the following precautions apply.

1. No more than three transmitters are to be installed in one rack.

2. Establish clearance space of at least twelve inches between equipments in each rack.

3. The rack cabinet rear door must be removed completely to allow proper air circulation. Operation of the equipment should not be attempted with the door in place.

4. Installation of both transmitters and receivers in the same cabinet is not recommended. Each transmitter

will dissipate 700 watts in the form of heat, and close proximity to receiver equipment may contribute to receiver failure.

It is requested that field activities supply the Bureau with complete failure reports on the TED transmitter and the Bureau invites comments or suggestions for improved operation and maintenance of this equipment.

FAILURE OF BLOWER MOTOR

Failures of the ventilating system in Radio Transmitting Equipment TED series have been traced to excessive wear of the blower motor brushes. The brushes supplied with the first procurements of these equipments proved to be too soft, resulting in rapid wear. Although the instruction books call for weekly checks for adequate brush length, continuous operation of the equipment in some cases has resulted in failures in spite of adherence to maintenance schedules.

Equipments containing black motors manufactured by Rotron Mfg. Co. (Ser. No. 300 and above on TED-1) were supplied with brushes of harder material. Life tests on these brushes have shown that at least 1000 hours use can be expected. Gray Motors (also manufactured by Rotron), used in all TED and low serial number TED-1 equipments, had brushes of soft material.

Replacement brushes of the hard material are being distributed to supply points by the Electronics Supply Office. Stock on hand should be used before requisitioning the new brushes.

STOCKING AND DISTRIBUTION OF TEST CABLES

Heretofore, the number of test cables with certain equipments provided to ships and shore activities was excessive in the case of multiple installations. The new procedure for computing the appropriate number of test cables for multiple installations of the TDZ, TED Series, AN/URR-13 Series, AN/URR-27, and AN/URR-35 Series is contained in ESO Instruction 4441.11 of 12 January 1955. This instruction states that test cables in excess of requirements should be returned to stock. The cables are being included in the Electronics Maintenance Parts Allowance Lists for the above equipments to insure that activities retain a sufficient number of test cables. More economical use and realistic distribution of existing supplies of cables, and substantial savings in new procurements of equipment by deleting excess test cables should result from the adoption of this new procedure. Current contracts for procurement of the TED-7 and the AN/URR-35B,-35C have been modified to delete the requirements for test cables.

INSTALLATION OF THE DISTORTION MEASURING VOICE FREQUENCY TESTING AND LINE BAY EQUIPMENT

When installing the distortion measuring voice frequency testing and line bay equipment, used in conjunction with the D156000 TEF transmitter, certain precautions should be observed when making the installation tests.

The equipment includes coils in which it is necessary to avoid injury due to core magnetization. Ordinary d-c buzzers and similar devices should never be used for continuity tests. Only continuity test sets which can cause a **maximum test current of one milliamperes to flow** should be used.

It is essential that parts and contacts in the above equipment be clean since the failure of a circuit to function properly may often be traced to dirty contacts. In case a contact may be suspected of not being reliable, it may be checked by bridging a receiver across the contact through which current is flowing. Absence of fluttering in the receiver is evidence of a reliable contact.

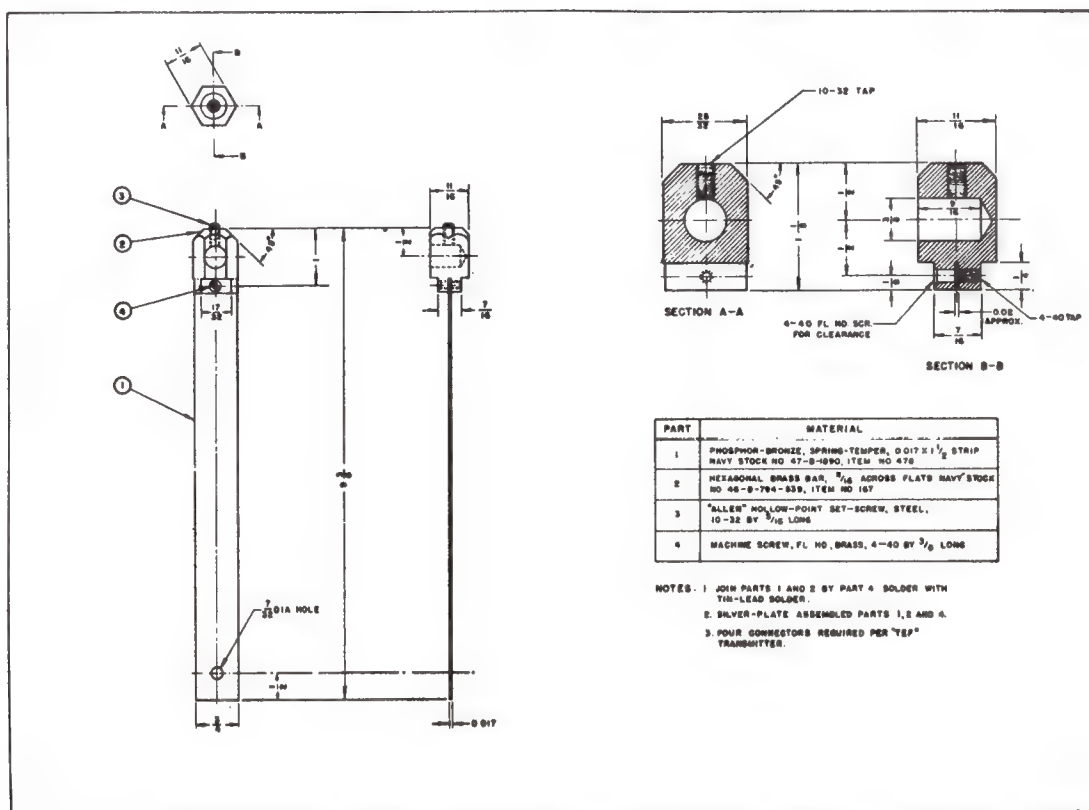
MODIFICATION OF FILAMENT CONNECTORS FOR TEF SIDEBAND TRANSMITTER

The Bureau has been notified that deficiencies exist in the power amplifier tube filament connectors of the TEF

single sideband transmitters. The connector material is flat, tinned copper braid, used as flexible connectors. Both ends of the braid are filled with solder for about one-half (1/2) inch to make them stiff. Holes are drilled in each stiffened end, for securing one end to a screw terminal, and for attaching a split cylindrical terminal to the other end. The cylindrical terminal is designed to fit over the tube filament prongs, relying on friction for mechanical and electrical contact. After prolonged usage the connectors show two (2) deficiencies. The terminal screws loosen at both ends, due to cold flowing of the soldered braid, and the cylindrical sleeves overheat, discolor and lose stiffness due to insufficient metallic contact area for the filament current.

Navy Communication Station, Annapolis, has designed a connector which has overcome these deficiencies. Figure 1 shows this connector together with a list of materials and instruction for assembly.

The Bureau approves this modification to be made on an optional basis. No kits are to be provided. Materials may be obtained from Navy Stock.



TN-197/URT PRESSURE GAUGE

It has been pointed out that the pressure gauge located on the output side of the Radio-Frequency Tuner, TN-197/URT, cannot be observed readily when the tuner is located in a vertical position near the top of the mast. They suggest that the pressure gauge be relocated.

In those installations where the input side of the tuner is visible from below, the gauge may be relocated as follows:

1. Take the pressure gauge from the output side of the tuner.

2. Close the opening with a pipe plug, Navy General Stores G4730-187-4237 or equal.

3. Take the air-escape valve from the input side of the tuner.

4. Insert a pipe tee, Naval General Stores G4730-277-8669, into the opening.

5. Insert the pressure gauge into the bottom of the pipe tee and the valve into the side opening.

Precautions should be taken to prevent leaks around the pipe threads.

In those instances where the input end of the tuner is not visible from below, the gauge may be mounted in a convenient location near the tuner assembly. A flexible hose should be used to connect the gauge to the tuner since the vibration of the mast may cause rigid tubing to break and leak.

SERVICE NOTES**NAYSHIPS****900,000.1****COMMUNICATIONS****TN-229/SRT DEFECTIVE R-F TUNERS**

The Bureau of Ships has been notified by various installing activities that r-f Tuner, TN-229/SRT was found defective when received from stock. The cause was attributed to the unit leaking nitrogen gas.

These tuners, when received by the Navy from the manufacturer, are pressurized to 20 lbs psi. This pressure

will gradually decrease due to leakage. After unpacking the r-f Tuner, the installer should check all screws to make sure they are tight. Before energizing the unit, the pressure should be checked. If the pressure gauge shows less than 20 psi, the unit should be repressurized, using Pressurization Kit MK-260/U.

ORIGINAL**TN-229/SRT:1**

RF TUNER TN-230/BRT CORRECTION OF DEFECTIVE DRIVE

The U. S. Navy Underwater Sound Laboratory has reported intermittent, noisy, and erratic travel of the movable short on the rf Tuner TN-230/BRT. This defect has been traced to a badly worn worm wheel which drives the worm gear attached to the clutch assembly.

Measurements made after dismanteling the drive system disclosed errors in vertical and horizontal alinement of the worm gear and wheel.

The vertical error was corrected by removing a 0.0065-inch shim underneath the clutch assembly. The horizontal

error was corrected by grinding about 0.010-inch from the surface of one of the clutch discs which faces the worm wheel.

Another possible cause of this wear could result from operation of the tuner in a horizontal position. This places excessive strain on the gears during the travel when the variable short winds up a fairly heavy spring which aids the tuning motor when it drives the variable short upwards.

A BUSHIPS field change will not be issued unless additional failure reports are received on this unit.

SERVICE NOTES

NAVSHIPS

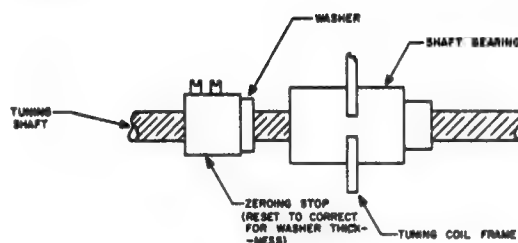
900,000.1

COMMUNICATIONS

ANTENNA TUNER TN-249/BRT MECHANICAL FAILURE

During recent tests, a mechanical fault developed in Antenna Tuner TN-249/BRT. When the tuning crank was rapidly returned to the zero position, the tuner would jam against the stop. This necessitated removing the tuner from the case to clear the jam.

This failure was corrected as shown in figure 1.



INSTALL 3/8" I.D. X 1" O.D. X 1/16" THICK NEOPRENE WASHER AS SHOWN IN SKETCH TO PREVENT SEIZING BETWEEN SURFACES OF THE STOP AND THE BEARING WHEN TUNER IS CRANKED TO "0" POSITION.

Figure 1

ORIGINAL

TN-249/BRT:1

MODIFICATION OF TAP-CHANGING TIMING RELAY K-249

A field installation reports that difficulties have been encountered with the automatic, plate transformer tap-changer of the TPA power amplifier. The tap-changer mechanism could not be adjusted to change the taps on the plate transformer and simultaneously close the associated plate interlock contacts under all conditions of normal operation. The timing adjustment could be made reliable for either clockwise or counterclockwise rotation of the tap-changer mechanism but not for both directions of rotation. (Closure of plate interlock contacts depends on the rotation of the tap-changer mechanism to a degree sufficient to allow the interlock contacts to close. The extent of rotation is controlled by an adjustable timing circuit using an electronic tube, as shown in detail on the schematic diagram, Fig. 2-15, of the TPA instruction book.)

To effect satisfactory operation, the timing circuit has been modified to provide two automatically selected timing adjustments, one for clockwise rotation of the tap-changer mechanism and the other for counterclockwise rotation. The circuit modification is shown in figure 1.

The circuit modification consists of the addition of a 10,000-ohm wire-wound potentiometer, or rheostat, and a pair of normally open contacts. The effect of the modification is to employ a different grid voltage on the electronic timing tube for each direction of the tap-changer rotation. The original timing circuit components are effective for one direction of rotation while in the other direction the additional potentiometer is in the circuit, automatically changing the grid voltage on the timing tube. The additional contacts are mounted on one of the tap-changing motor control relays, either on relay K-247 or relay K-248, depending upon which direction of rotation requires it.

Modification instructions.—1—Prior to modifying the circuit, adjust potentiometer P1 so that the tap-changer synchronizes with the plate interlock relay in one direction of the tap-changer rotation, and overshoots the interlock closing position in the other direction of rotation. Overshooting is indicated by the plate voltage ready light coming on momentarily and then going out as the tap-changer reaches its position of rest.

2—Identify the motor control relay, either K-247 or K-248, as being operative when the tapchanger and the interlock contacts synchronize properly.

NOTES;

1— NORMALLY OPEN CONTACT ADDED TO CW ROTATION RELAY K-247 OR CCW ROTATION RELAY K-248.

2—10,000-OHM WIRE-WOUND POTENTIOMETER, OR RHEOSTAT.

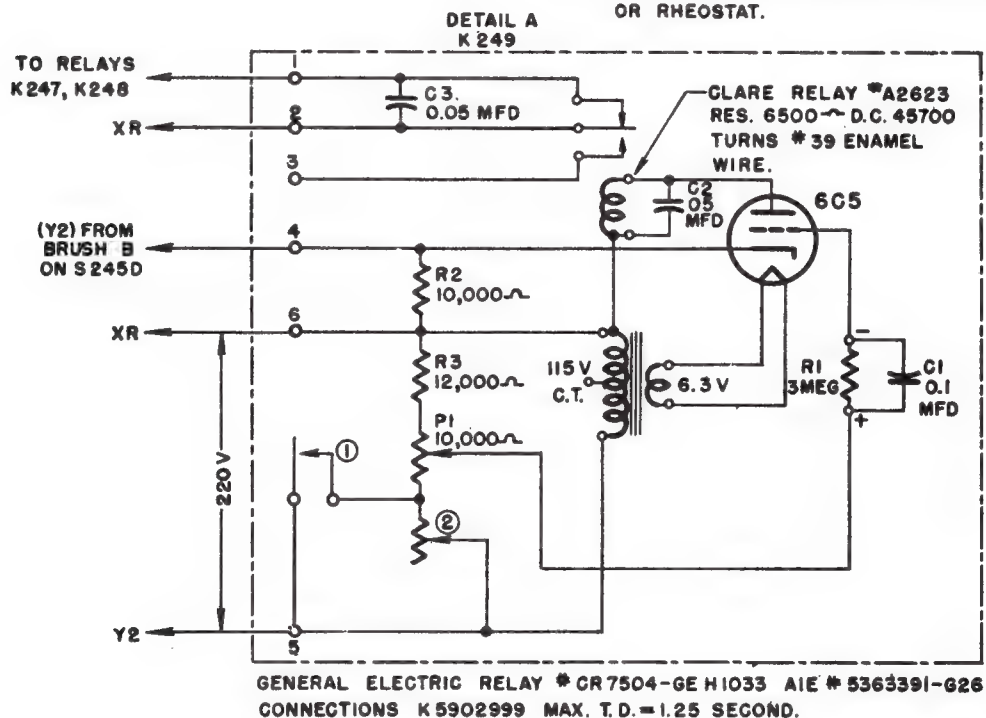


FIGURE 1.--Modified tap-changing timing relay K-249

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

3--Install on this relay an additional pair of normally open contacts.

4--Install a 10,000-ohm wire-wound potentiometer, or rheostat, in conjunction with the normally open contacts provided above, as shown on the attached schematic diagram.

5--Adjustment of the additional potentiometer, or rheostat, is made by repeated trials with the tap-changer

mechanism rotating in the direction in which the additional potentiometer, or rheostat, is effective.

Field installations are cautioned that the above modification is not approved unless the Field Change 3-TPA has been effected, or is effected concurrently with the above modification.

USE OF MULTIMETER TS-297/U IN PLACE OF TEST METER TS-80/U WITH RADIO SET AN/ARC-1

There have been many requests from Naval activities concerning Test Meter TS-80/U. For proper loading and aligning of the AN/ARC-1 Transmitter-receiver, a TS-80/U or its equivalent is necessary.

Multimeter TS-297/U is a suitable meter for use in lieu of TS-80/U. Although its smallest milliamper scale is 0 to 4 milliamperes, the TS-297/U, if used as described below, will give equal or greater sensitivity for AN/ARC-1 adjustments than the TS-80/U.

TS-297/U Circuitry

When making transmitter performance checks on the AN/ARC-1, equal or greater sensitivity may be obtained by substituting Multimeter TS-297/U for the TS-80/U. No circuit changes are necessary in the TS-297/U to obtain the desired meter readings, shown in Table 1, for the AN/ARC-1 transceiver.

On the first inspection of the meter, it will be observed that the smallest milliamper scale is from 0 to 4 ma. Since the maximum current to be measured on the AN/ARC-1 performance check is only 1 milliamper, the TS-297/U would appear to be useless. However, by examining the internal circuits of the TS-297/U, some very important facts are brought out.

Directly under the meter is an OHMS-ZERO ADJUST knob, and below this knob is a selector switch for selecting OHMS, AC or DC. The meter does not have a range selector

switch so the test leads must be plugged into the jacks of the desired scale to be used. On the right hand side of the meter, a common jack is used for $\pm$ VOLTS, - MA, and OHMS.

In taking readings with the TS-297/U, the zero to one hundred scale will be used. These readings are not actual values of voltage or current but only relative meter indications. Table I shows the order of magnitude obtained on the TS-297/U for the various metered stages of the AN/ARC-1.

A composite circuit diagram, Figure 1, shows all of the circuits when the selector switch is in the DC position. A series of shunt resistors are connected across the meter so that the meter will not exceed the current rating of its movement, 250 microamperes with 62.5 millivolt drop.

With the selector switch in the DC position, the red lead of the test cable inserted into the 4V jack and the black lead inserted into the $\pm$ VOLTS jack, the meter will have a full scale deflection when 4 volts is impressed across it and the circuit will draw 1 milliamper of current. Figure 2 shows the connections to be made on the front panel of the meter and the internal circuit when the above cable connections have been made. Since the circuit will draw 1 ma, it alone may be used in place of the TS-80/U. With less than 0.6 ma flowing in the circuit, the sensitivity of the TS-297/U drops so that the readings are below 25 on the 0-100 scale. Therefore the 4V jack connection should be limited to readings above 0.6 ma.

Table 1.--AN/ARC-1 transmitter performance check

Meter switch	Dial head	Cycle key test switch	Dial heads	TS-80/U	TS-297/U			
					Figure 3 4-volt jack to GND	Figure 4 Rx100 to GND	Figure 5 Rx10 to GND	Figure 6 Rx1 to GND
OSC Ig	None	Keyed	No adjust	0.1 to 0.2	5	20	43	45.
MIX Ig	Rec	Not keyed	Maximum current	0.3 to 0.6	7.5	25.5	73	85.
DRI Ig	Trans	Keyed	Maximum current	0.0 to 1.0	5	15	48	60.
PA Ig	Trans	Keyed	Maximum current	0.6 to 1.0	8	35	98	Off scale
PA Ik	Ant	Keyed	Tune for resonance	0.6 to 0.8	75	Off scale	Off scale	Off scale
MOD Ik	None	Keyed	No adjust	0.6 to 0.9	50	Off scale	Off scale	Off scale

Note.--On TS-297/U, the 0 to 100 scale is divided by 100 to obtain the above readings. Jack positions which give OFF SCALE readings are not used.

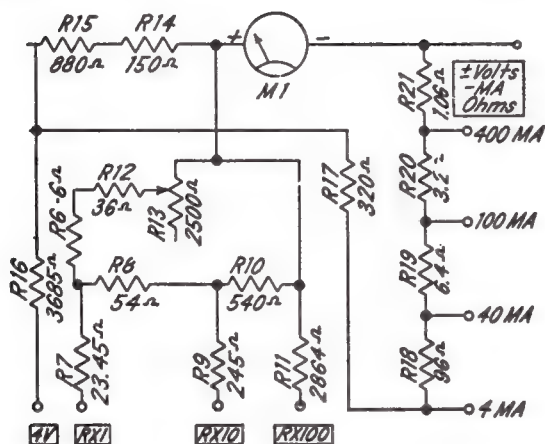


FIGURE 1.--Internal circuitry of Multimeter TS-297/U with selector switch on DC

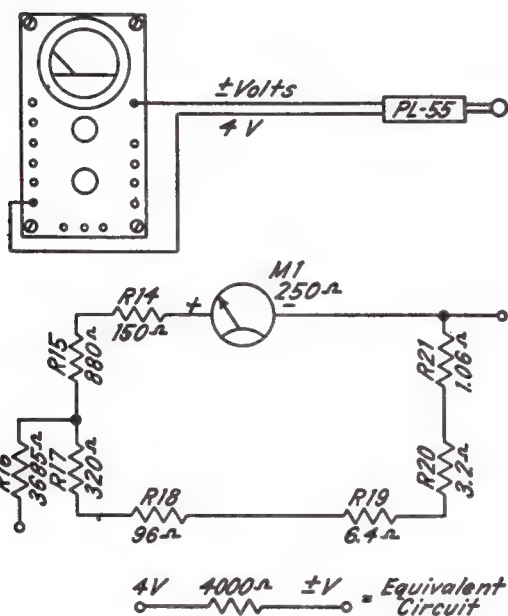


FIGURE 2.--Internal circuitry of Multimeter TS-297/U using 4-volt jack

To obtain more sensitive readings on the 0-100 scale, the Rx100, Rx10 and the Rx1 jacks are used as indicated in Figures 3, 4, and 5. The selector switch is placed in the DC position and the OHMS-ZERO ADJUST control is turned full counter-clockwise. Examination of Figures 3, 4, and 5 will show that Rx100, Rx10, and Rx1 place resistances in series with the meter and in this way form a sensitive voltmeter circuit. Under normal operating conditions, the meter appears to be damped sufficiently to withstand a small overload without damage to the needle.

For increased protection to the meter, however, all readings should be taken on the least sensitive (4V to GND) position first, as this represents 1 ma deflection or

the sensitivity of the TS-80/U. If this first reading indicates that more sensitivity is desirable, one of the more sensitive positions may be used, as shown in Figures 3, 4, and 5.

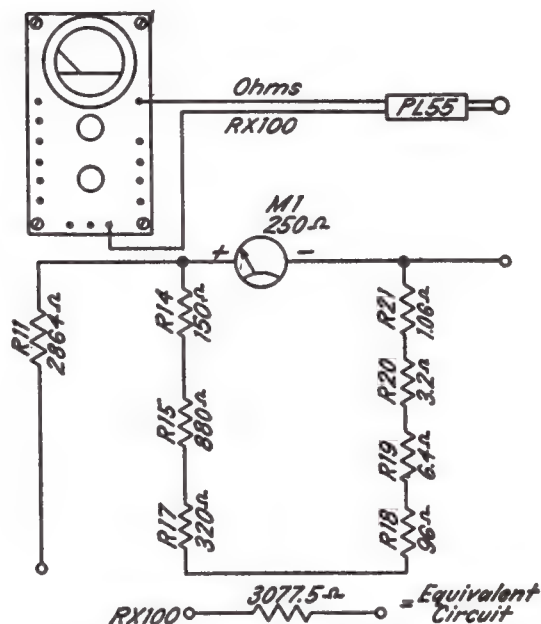


FIGURE 3.--Internal circuitry of Multimeter TS-297/U using Rx100 jack

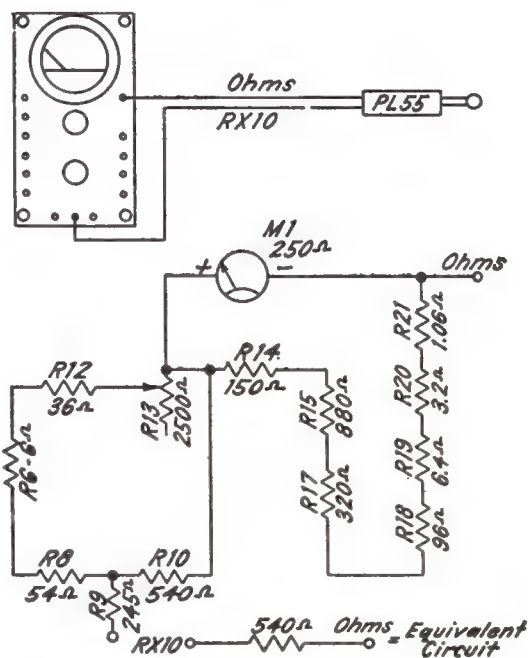


FIGURE 4.--Internal circuitry of Multimeter TS-297/U using Rx10 jack

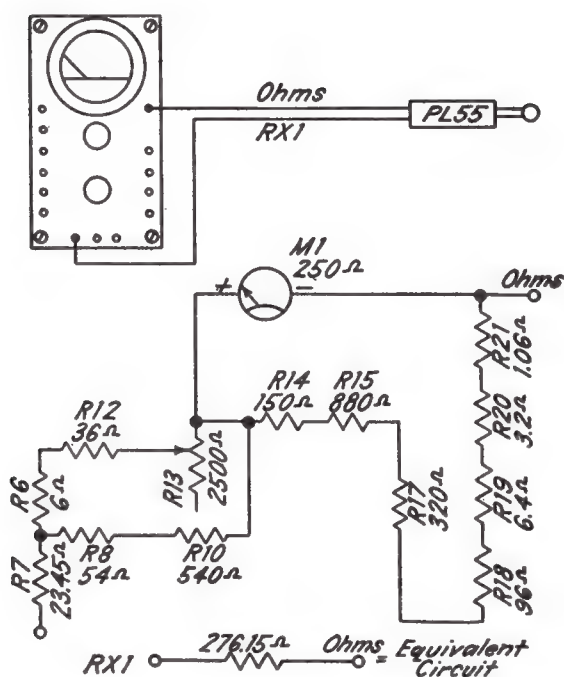


FIGURE 5.--Internal circuitry of Multimeter TS-297/U using Rx1 jack

Additional Test Leads

Supplied with the meter is a test cable, CX-468/U, which contains a red and black test probe on one end and a standard phone plug, PL-55, on the other. In case this cable has been misplaced or lost, a set of test leads may be constructed as shown in Figure 6.

To fabricate a set of test leads, two pieces of number 16 stranded rubber-covered wire approximately 36 inches long will be required. Two short test probes, color coded black and red, and a standard PL-55 phone plug will also be needed. The wire leading from the red probe will be connected to the screw toward the front of PL-55, and that leading from the black probe will be connected to the screw located on the brass body of PL-55.

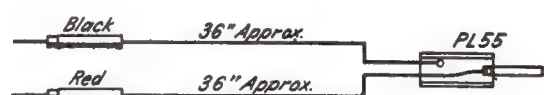


FIGURE 6.--Details of construction for additional test leads

SERVICE NOTES**NAVSHIPS 900,000.1****COMMUNICATIONS****TSEC/HW-10 Brush Tension**

Reports indicate that it is difficult to maintain proper distributor brush tension on the TSEC/HW-10 special transmitter distributor used with the TSEC/HW-19A. The following information should assist maintenance personnel with cleaning and adjusting the distributor mechanism of TSEC/HW-10.

1. Make sure the commutator disk is clean, tight, and accurately positioned.
2. Install resistor clamp CE-75803 downward. (See fig 46 of Maintenance Manual KAM-7/TSEC).
3. Make sure that brush springs are not bent excessively, then adjust brush pressure in accordance with paragraph 6028 of KAM-7/TSEC.

If operation is not improved after the above measures are taken, the following method may be tried: Add an extra spring leaf next to and directly over each brush spring. The added leaves are made of commercial brass sheet 0.0079-inches thick, FSN-GX-9535-232-6943, or equivalent. Two leaves are required. The leaves should measure 11/16 in. by 1/8 in. when completed. They should be clamped in the same manner as the original brush springs. The adjustment is given in the TSEC/HW-10 maintenance manual.

This suggestion was made by . James K. Fuse of the Pearl Harbor Naval Shipyard.

SERVICE NOTES**NAVSHIPS 900,000.1****COMMUNICATIONS****TSEC/HW-19A**

Information from the Electronics Supply Office indicates a high failure rate in the power transformer (T-1) of TSEC/HW-19A. Over 200 replacements have been made, but only 9 failure reports (DD-787) have been received by the Bureau. To aid a Bureau investigation, it is requested that all activities that have failures of this item from 1 April to 1 July 1961, forward the defective transformer to the Bureau, Code 687G, for evaluation.

ORIGINAL**TSEC/HW-19A:1**

SERVICE NOTES**NAYSHIPS 900,000.1****COMMUNICATIONS****TSEC/KO-6A Erratic Operation**

Erratic operation has been reported occurring in TSEC/KO-6A equipment, which could not be identified and corrected through normal maintenance-checking procedures outlined in the maintenance manual. This erratic operation may have been caused by control-tube oscillations or a defective-filter capacitor in the regulated power supply,

and can be detected by checking the outputs of the 50 vdc, 75 vdc, and 200 vdc supplies with an oscilloscope.

Erratic operation may be corrected by:

1. Replacing the control-amplifier tube.
2. Replacing the series-control tube.
3. Checking and replacing defective-filter capacitor, if required.

ORIGINAL**TSEC/KD-6A: 1**

SERVICE NOTES

NAVSHIPS

900,000.1

COMMUNICATIONS

TSEC/KW-22 Maintenance

1. TSEC/KW-22 should be operated with the drawers closed to maintain proper air circulation within the equipment. The filters should be cleaned in accordance with paragraph 5002d of KAM-53/TSEC. Equipment operators should be certain that the exhaust louvre at the top rear of the equipment is open when the equipment is in operation.

2. In the event overheating occurs, even though the steps in paragraph 1 have been followed, the blower-motor wiring should be checked. Some equipments have been delivered with blower motors improperly wired and, as a result, are operating at approximately 50 percent efficiency. Refer to KAM-54/TSEC for the proper color codes of the motor leads.

TSEC/KW-22

A limited number of the following items are now available through normal Navy supply channels:

1. W-1403, KWG-22/TSEC Drawer Interconnecting Cable Assembly (Transmit) N5810-691-1301.
2. W-1503, KWG-22/TSEC Drawer Interconnecting Cable Assembly (Receive) N5810-691-1299.

Replacement cable clamps (KAB Modification) for cable assembly W-1403 will be available approximately 1 February 1961 and will be distributed without request to all holders through the Registered Publication System. These new clamps will aid in the prevention of lead breakage in cable assembly W-1403.

Performance and Operational Reports

Electronic Performance and Operational Reports, NAVSHIPS 3878, are to be submitted in accordance with Bureau of Ships Technical Manual, chapter 67, paragraph 67-127(b) (3), for the TSEC/KW-22, TSEC/KW-36, TSEC/KW-37, and TSEC/KO-6A.

TSEC/KW-26 Maintenance

1. Air filters in the TSEC/KW-26 equipments should be checked frequently for cleanliness, and should be cleaned in accordance with paragraph 4505, page 264, of KAM-37B/TSEC. Dirty or clogged filters may cause undesirable high temperatures within the equipment. The TSEC/KW-26 should be operated with the drawers closed to provide proper circulation of air.

2. When turning on the ac switch (S-1) on the transmitter and receiver units of TSEC/KW-26, the operator must wait at least one minute before turning the dc switch (S-2) on these units, to prevent possible damage to tubes and other components.

3. The life of the 6216-type tubes used in the BA1000 package of TSEC/KW-26 may be increased by operating the receive teletypewriter printers at less than 60 ma. It is recommended that the output line current to the receive printers be reduced to a minimum which will still maintain proper printer operation. NOTE: When changing the TTY-line current, balance must be maintained by adjusting the dummy load potentiometer.

4. When requisitioning the 6216-type tube, Federal Stock Number N5960-752-5393 should be used to insure receipt of the improved type tube with gold plated grids, identified by red paint on the tube envelope tip. Some

gold-plated-grid tubes without red paint on the tip are included along with the non-plated-grid type under stock number N5960-636-2221; however, the new-stock-numbered tube should be used in TSEC/KW-26.

5. The pulse transformers T-301, T-302, T-501, and T-503 have been the cause of failures in TSEC/KW-26, due to poor insulation in the transformer. When these transformers develop internal shorts, a number of associated components are destroyed. It is anticipated that the Bureau will furnish holders of TSEC/KW-26 with bulk replacements for all transformers of inadequate design. Details of distribution will be forwarded to holders, by the Bureau.

TSEC/KW-26

The Series 72 Sigma Relay (K202) in the KW-26 should not be discarded if erratic operation is experienced due to contact wear or maladjustment. All shipyard CRF's have been supplied with Sigma Relay Testers for alignment purposes and repair kits for the replacement of the relay armature and contacts. Relays from security equipment afloat which require realignment or the armature and/or contacts replaced should be taken or shipped to the nearest shipyard CRF for repair. The CRF's have not been supplied with the necessary parts to perform any other repairs on these relays since such repairs would exceed the cost of a replacement relay. No charge will be made by the CRF for this service. In emergencies or in unusual circumstances shipyard CRF's will do this work for shore activities. Normally shore activities are expected to maintain and repair their relays.

All KW-26 holders listed in the enclosure to Bureau letter Ser 687G-0142 of 6 September 1960 are advised that there will be about a 60-day delay in the shipment of these tools previously scheduled for shipment prior 30 November 1960.

TSEC/KW-37

The equipment front-panel meter-selector switch should be in the OFF position during operating periods so as not to interfere with the output signal to the teletype equipment. This switch is intended for initial set-up and checking purposes and is not required for monitoring during operating periods.

Maintenance personnel are cautioned about the heater in the dessicator unit which is turned on only when the equipment drawer is extended. For safety reasons, this dessicator-heater unit should be disconnected by unplugging its power plug (P1) during prolonged maintenance periods in which the drawer is extended. The top of the equipment cabinet can reach a temperature at which minor burns will be received by personnel touching the cabinet if this practice is not

followed. Personnel are further cautioned that 110 volts a.c. is present at the dessicator-fuse clips when the equipment power switch is in the OFF position. A safety interlock will be added to interrupt this voltage when the fuse cover is removed. Additional information will be published at a later date.

Installing activities should secure the KWR-37 receiver with four bolts up through the mounting shelf into the threaded holes in the equipment feet, as outlined in KAM-78A/TSEC. This method is preferred over the installation information on BUSHIPS drawing RE-67-F-2162G which shows 16 mounting bolts (4 per foot), since installation and removal of the equipment would be simplified. Activities which now have the equipment installed using all 16 holes need not change the installation, since both methods are satisfactory.

NAVY FIELD CHANGE NO. 1-TT-23/SG

Replacement of Jack Washers and Nuts and Rewiring of Meter Circuits

Equipment affected. - All Teletype Panels Type TT-23/SG.

Purpose. - (1) To allow sufficient tightening of jack-nuts and to eliminate shorting of jacks to panel. (2) To relocate the meter in the positive leg of looping circuit in order that it cannot be in any common return which might be caused by grounding one side of the keying circuit of two or more equipments (when a common power supply is used). (3) To reverse the meter connections where required.

Time required. - Two man-hours.

Material required. - The following material is supplied with this field change:

- 24 Insulating bushings.
- 24 Flat insulating jack washers.
- 24 Jacknuts.
- 3 Type SRIR-1 (7) hook-up wire (orange).
- 2 Instruction pamphlets.

Tools and instruments required. -

- 1 - 1/2-inch Spintite or socket wrench.
- 1 - 9/16-inch Spintite or socket wrench.
- 1 - Soldering iron and solder.
- 1 - Pliers, long nose.
- 1 - Pliers, diagonal, wire cutting.
- 1 - 3/8-inch Spintite or end wrench.

Procedure. - Complete instructions for accomplishing this change are contained in the bulletin accompanying the field change kit.

Routing instructions. - When this field change has been completed, personnel making the change shall:

(1) Scrap all parts removed from the Teletype Panel TT-23/SG.

(2) Make the proper entry on the Electronic Equipment Machinery History Card, NAVSHIPS 536, and enter completion date on Field Change Record Card NAVSHIPS 537.

(3) Fill out and mail the self-addressed, notification card, NAVSHIPS 2369, which is included as part of this field change.

(4) Destroy the original List of Parts and the Circuit Diagram supplied with the new Instruction Pamphlet supplied with this field change.

This field change can be obtained through the Electronics Officer of any Naval Shipyard or from the Electronics Supply Centers. 1/1/49

TT-23B/SG REPLACEMENT OF RHEOSTATS

Mr. John J. Hizny, of the Boston Naval Shipyard, has submitted a beneficial suggestion proposing that defective line-current rheostats R101, R103, R104, R105, R106, and R107, in the TT-23B/SG Teletype Panels be replaced with MIL type parts. The Bureau of ships concurs with this suggestion.

The parts list for these resistors in NAVSHIPS 91480 should be changed to reflect the use of MIL resistor type

RP101FD252KK, Standard Navy Stock Number N16-R-090870-9091.

reset bail mechanism in teletype writers have caused broken function pawls, symbol number 0-1445 in Teletypewriter TT-47A/UG, TT-48A/UG, TT-69A/UG, TT-70A/UG, and symbol number 0-1433 in Teletypewriter TT-47/UG, TT-48/UG, TT-69/UG, TT-70/UG.

The manufacturer investigated this condition and recently advised the Bureau that new adjustments, outlined below, will prevent further breakage of function pawls. An instruction-book change will be issued to cover this information. All ships and activities should note these new adjustments in order that damage to function pawls can be prevented.

For TT-47A/UG, TT-48A/UG, TT-69A/UG and TT-70A/UG: refer to Instruction Book, NAVSHIPS 91713, page 7-66. Function reset-bail adjustment: with the function clutch and type-box clutch in their stop position and the function pawls unlatched from their function bars, there should be from 0.025 to 0.035 inch clearance between the front edge of the function bar and the edge of the bar blade when the function bar is held in its maximum, rearward position. Measure this clearance on the automatic carriage return and inner-line feed-function bars. On function boxes having any slots between Nos. 10 and 30 occupied by function bars, measure function bars closest to each of the blade-inner-mounting screws.

CAUTION

This adjustment is to be checked with the function clutch in the stop position which results in the least clearance and with the carriage return-lever clamp-screw loosened. To adjust, position the blade on the function bail with the blade-mounting screws friction tight.

NOTE

With the type box rotated about one half revolution and each function lever held in its maximum rearward position, the associated function pawl should hook over its function bar with not less than 0.006 inch clearance when pulled with a tension not more than 16 ounces. Do not latch more than one pawl at a time because function bail loads affect pawl clearance. The shift-code bar should have some end play when the letters and figures function pawls are alternately latched on their function bars. If necessary, refine the above adjustment and the shift code-bar operating-unit adjustment to meet these requirements. Also, make the following addition to the conditioning operations: 'Loosen the carriage return-lever clamp screw.

For TT-47/UG, TT-48/UG, TT-69/UG and TT-70/UG: refer to Instruction Book, NAVSHIPS 91393, page 7-63. Function reset-bail adjustment: With the function clutch in

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

the stop position and the function pawls unlatched from their function bars, there should be from .025 to .037 inch clearance between the front edge of the function bar and the edge of the function bail (or bail blade) when the function bar is held in its maximum rearward position. Measure this clearance on the automatic carriage-return bell, and inner-line, feed-function bars.

CAUTION

This adjustment is to be checked with the function clutch in the stop position which results in the least clearance. To prevent other parts from interfering with this equipment, loosen the carriage return-lever-clamp screw and the shift-code-bar operating-slides clamp nuts. To adjust type units equipped with nonadjustable function-bail blades, add or remove 0.004 inch shims (No. 152115) between the function-bail-link operating arms and the function-reset shaft.

To adjust typer units equipped with adjustable-function bail blades, position the blade on the bail with the blade-mounting screws friction tight.

NOTE

With the type box clutch rotated about one half turn and the function lever held in its maximum rearward position, each function pawl should hook over its function bar with not less than 0.006 inch clearance when pulled with a tension of not more than 16 ounces. Do not latch more than one pawl at a time because function bail loads affect pawl clearances. Refine the above adjustment to meet the requirements, Remake the shift code-car operating-unit adjustment.

NEW FUNCTION PAWL FOR TELETYPE WRITERS

Numerous reports indicate a high breakage rate of function pawls (Symbol Designations 0-1433 and 0-1445 through 0-1455) in the above equipments. The Teletype Corporation has advised the Bureau that these function pawls are superseded by a newly-developed pawl, Mfr. No. 152653, Standard Navy Stock Number N17-T-350015-272. This new pawl can be used interchangeable in TT-47/UG, TT-48/UG, TT-69/UG, TT-70/UG and TT-47A/UG, TT-48A/UG, TT-69A/UG, TT-70A/UG.

In the Instruction Book, NAVSHIPS 91393, Section 8, Symbol Desig. 0-1433, delete Mfr. No. "150564" and insert

Mfr. No. "152653". Delete SNSN "N17-T-350014-200" and insert SNSN "N17-T-350015-272". These numbers will be corrected officially in an Instruction Book change.

TELETYPEWRITER PANEL TT-23/SG

The Commanding Officer, U.S.S. Everglades (AD-24) reports a safety hazard in this transfer panel. When the d.c. loop current supply is energized, a patchcord plugged into a loop jack may show 110 volts d.c. between the metallic sleeve of the plug on the free end and ground. Voltage may also be present between the sleeve and tip of the plug on the free end of the patchcord. Once both ends of the patchcord are plugged in, this hazard is removed. However, small exposed portions of the jacks and plugs may still show voltage to ground. Commander Destroyer Force, U.S. Atlantic Fleet has also noted the hazard involved in using metallic dummy plugs.

A suggestion by Roberts, Chauncey W., RMCS in Everglades, for elimination of the hazard, was forwarded by the Commanding Officer and is under consideration by the Bureau of Ships. Commander Destroyer Force, U.S. Atlantic Fleet has suggested a protective plexiglass panel which would prevent exposure of the metallic portions of plugs and jacks, after patchcords have been plugged in. This suggestion is also being processed by the Bureau.

In the meantime, personnel concerned are advised to use caution when handling the patchcords. When possible, the d.c. power supply should be turned OFF during patching. If this is not feasible, the plugs should be handled carefully, grasping only the insulated portions. Only nonmetallic dummy plugs should be used.

MEASUREMENT OF TELETYPEWRITER LINE CURRENT ON SHIPS WITHOUT A TT-23()/SG TELETYPEWRITER PANEL

It has been suggested that the teletypewriter loop current be adjusted on ATF class ships. The ATF ships use CV-89()/URA-8A Converters, TT-47()/UG Teletype-writers and a PP-1010/UG Power Supply, or equivalent equipments.

The current may be measured by plugging in the AN/PSM-4 phone plug adapter into the teletype loop jack on the converter, tuning in a mark signal on the receiver and adjusting the line current rheostat on the PP-1010/UG for a 60 milliamperere reading on the AN/PSM-4 meter. If a PP-424/U power supply is used, the current may be adjusted by changing the input and output taps on the power transformer.

The line current should be checked weekly.

TT-47/UG FRICTION OF SPINDLE

The Bureau has received a beneficial suggestion proposing that, in some cases, the sharp hexagonal edges of the paper spindle of TT-47/UG Teletypewriters should be rounded to reduce excessive friction on the guide blocks. The Bureau of Ships concurs in this suggestion.

In those cases where excessive drag on the line-feed mechanism is due to the friction of the spindle in the guide blocks, the bearing surfaces of the spindle should be polished with emery cloth and the shaft ends coated with a thin film of lubricating grease MIL-G-3278.

TT-47/UG TELETYPEWRITERS LUBRICATION OF SPRING POSTS

A beneficial suggestion has been received indicating that considerable wear may occur between some springs and spring posts in the TT-47/UG and TT-47A/UG Teletypewriters. It has been suggested that the wear be reduced by installing a felt washer, Standard Navy Stock Number N17-T-350012-728 saturated in KS-7470 Lubricating Oil, back of the springs which have excessive wear.

The Bureau of Ships authorizes the use of such saturated washers to reduce excessive wear on any spring post in teletype equipment.

GARBLING

A field report revealed that after complete adjustment and lubrication of the TT-50/UG teletypewriter, it continued to garble the received copy. It was determined upon removal and examination of the main shaft that the ball bearing (Teletype Part No. 72644) and cam sleeve assembly (Teletype Part No. 91265) were badly worn. This condition caused excessive binding of mechanical parts to the extent that proper selection could not occur. Replacement of these worn parts and readjustment of the selector mechanism restored the teletypewriter to service in a satisfactory condition.

This note also applies to teletypewriters which may be installed aboard ship: TT-5/FG, TT-7/FG, TT-49/UG or other teletypewriters with commercial nomenclature such as Teletype Corp. Model 15.

OPERATION WITHOUT LINE-SHUNT RELAY

When the line-shunt relay (Symbol No. K-1101, Stock No. N5945-237-1139) is deenergized, it contacts close the signal line circuit in the teletypewriter. When this occurs, the teletypewriter becomes inoperative. This condition may be caused by: (a) Loss of main a-c power; (b) Blown fuse; (c) Turning the a-c power switch to the "off" position; (d) Removing the typer unit from its base; (e) An open line-shunt relay coil.

Of the above cases, an open relay coil is the most difficult to detect and repair.

Reports from naval shipyards indicate that vessels have turned in for repair teletypewriters with only a defective line-shunt relay. In some instances, the coil had opened and insulating material had been inserted between the relay contacts. A spare relay was not provided with the equipment and a replacement was not immediately available from stock. Therefore it became necessary to disconnect the coil and contacts from the internal a-c and d-c circuitry to restore the teletypewriter to service and thereby meet the ship's availability date.

It has been suggested that the relay be disconnected from the internal circuitry when the relay is defective and a replacement is not immediately available. The procedure suggested, to render the relay inoperative is as follows:

(1) In TT-47/UG, TT-48/UG, TT-69/UG, TT-70/UG. (See technical manual, NAVSHIPS 91393). Remove and tape leads C-25-0 and C-40-BL on switch S-1103. This removes the a-c from the coil of relay (K-1101). Remove and tape lead C-9-W on terminal 10 of the terminal block (TB-751). This removes the relay contacts from the d-c signal line.

(2) In TT-47/UG, TT-48A/UG, TT-69A/UG, TT-70A/UG. (See technical manual, NAVSHIPS 91713). Move the strap on terminal No. 5 to terminal 4 on terminal board TB-1104. This removes the a-c from the coil of K-1101. Remove and tape lead A-19-W on terminal 10 of terminal board TB-751. This removes the shunt contacts from the d-c signal line.

To restore a teletypewriter to service with an open shunt relay coil, it is recommended that the relay be temporarily disconnected in accordance with the above procedure. However, a replacement for the defective relay should be obtained from stock and installed as soon as practicable.

Note that with the line-shunt relay disconnected from the internal circuitry, there is no automatic means to close the signal line to prevent the teletypewriter (or other teletypewriters in the same signal circuit) from running open in case the a-c power switch is turned off or the typer unit is removed from its base. If the signal line or loop is opened because of these conditions, it will be necessary to close the line at the teletype panel by inserting a plug in the set jack.

LINE CURRENT REQUIREMENTS**TELETYPEWRITER TT-47/UG, TT-47A/UG, TT-48/UG, TT-48A/UG, TT-69/UG, TT-69A/UG, TT-70/UG, TT-70A/UG**

The above teletypewriter equipments and later equipment including keyboard typing reperforators are equipped with a holding magnet selector mechanism and are wired for 60 milliamperes operation. Their internal selector magnets are connected in parallel. Although this equipment is capable of satisfactory performance on a line current as low as 20 milliamperes by connecting their magnets in series, other considerations are necessary. Older equipments installed aboard ship require a 60 milliamperes line

current because of their type of pulling magnet selector mechanism. Until such time as certain improvements are incorporated in all terminal, teletypewriter and auxiliary equipment, each loop connecting equipment through Teletype Panel TT-23()/SG must be adjusted to operate on a current of 60 milliamperes.

In connection with integration of radio teletypewriter equipment in a send loop, certain voltage requirements are also necessary. In the Keyer, KY-75/SRT, or similar keyers, and transmitters which have a built in f-s keyer, such as Radio Transmitting Set AN/UR T-2, 3, and 4, the teletypewriter key line input is terminated by resistors which vary from 40,000 to 150,000 ohms. One side of the resistor is normally grounded. This resistance is sufficiently high to reduce line current to a value far below the required 60 ma. It is therefore necessary to insert a parallel resistance to obtain the 60 ma. for the teletypewriter and 40 to 80 volts for the f-s keyer. The most desirable location for the parallel resistor is across line terminals 1 and 2 of the TT-23()/SG panel. Location of the resistor at this point confines loop current to the panel and local teletypewriter lines. Voltage developed across this resistor is applied to the f-s keyer at a current of less than 1 milli-ampere. The value of such a resistor has been determined to be 800 ohms (JAN type RW-51-G-801, 10 watt, 5%, wirewound, dimensions, 2 in. X 5/8 in.).

Typical circuitry of a send loop in TT-23()/SG, terminated by a teletypewriter across terminals 3 and 4, and a f-s keyer and terminating resistor across terminals 1 and 2, is shown in send circuitry portion of accompanying illustration. The 1000 ohm limiting resistor in the positive leg of each loop should never be strapped out of the circuit because it serves to protect the panel meter and teletypewriter selector magnets in the event of a cable or equipment ground.

With 120 volts applied to the loop, the following table shows the minimum and maximum loop currents and keyer input voltages obtained with the 800 ohm resistor across terminals 1 and 2:

Total Loop Resistance	Total Loop Current	F-S Keyer Input Voltage
1860 ohms	64 ma	51 volts
4360 ohms	27 ma	21 volts

The polarity of the voltage applied to the teletypewriter input terminals at the filter (Z-752) should be in accordance with that shown so that effective use is always made of the filter across key contacts in the teletypewriter. Contrary to other published information, the polarity shown on the miscellaneous jacks in the accompanying illustration is correct, and should be observed.

The internal loop circuitry in certain TT-23/SG, TT-23A/SG, TT-23B/SG, TT-23C/SG, TT-23D/SG, and TT-23E/SG panels has been found to be contrary to that shown in the illustration. Exceptions to the illustrated circuitry will not only restrict use of the panel but could introduce sufficient difficulties to cause unsatisfactory performance.

TT-47/UG:2

Lock nuts, metal washers, and insulating washers on jacks in various TT-23()/SG panels have been found to vary in thickness. These should be of proper size to permit positive tip and sleeve connections between the patch cord plug and jack.

Typical loop circuitry terminated in a teletypewriter and f-s converter is shown in receive circuitry portion of illustration.

CAUSE FOR CODE BAR WEAR

San Francisco Naval Shipyard reports that a majority of Teletypewriter TT-47/UG, TT-47A/UG, TT-48/UG, TT-48A/UG, TT-69/UG, TT-69A/UG, TT-70/UG, TT-70A/UG equipments overhauled by that activity have required replacement of the Common Code Bar (refer to technical manual, NAVSHIPS 91393, page 7-119). Apparently the Code Bars become worn from binding against the left and right vertical positioning levers, a condition that results from incorrect timing of the code bar clutch and type box clutch.

If the selector clutch is prematurely engaged during its stop period by an irregular signal impulse, the code bar clutch will be released before the type box clutch has completed its cycle. This will cause movement of the common code bar to the right before the vertical positioning levers have been returned to their stop position.

The common code bar (O-1338) will bind against the toe of the vertical positioning levers (O-1995 and O-1914) causing abnormal wear.

Correct tuning and constant monitoring is necessary to ensure that the audio output frequencies are correct in both frequency and amplitude. If these conditions are not satisfied, irregular signal impulses will result and thereby cause spasmodic triggering of the common code bar.

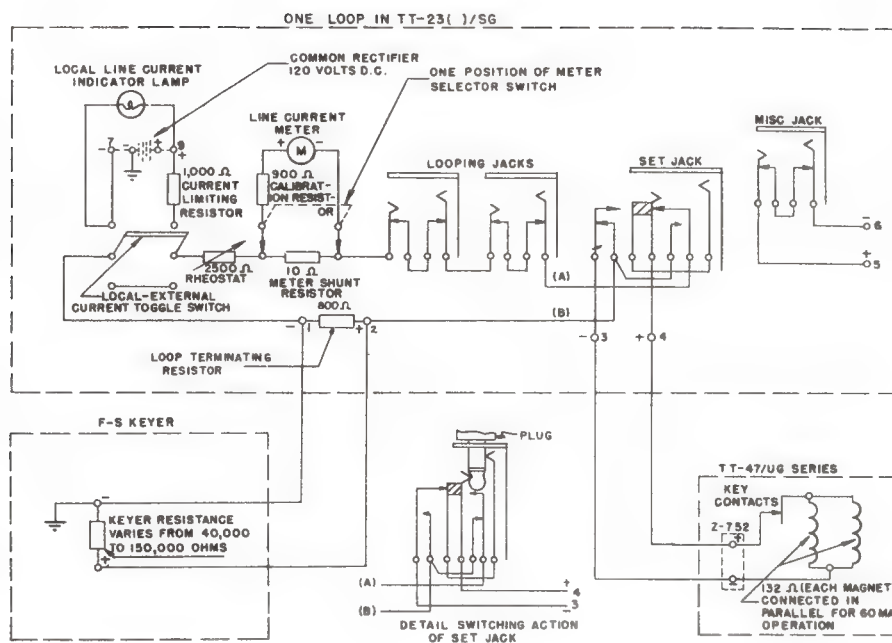
During reception of regular scheduled traffic, the receiver is usually tuned correctly. At all other times, the operating personnel neglect to place the terminal in a TUNE position. Incorrect tuning and unattendance of the equipment cause the teletypewriter to be triggered by random signals and/or noise.

Until a new code bar yield mechanism is developed to correct this condition, it is recommended that all shipboard operating personnel utilize the TUNE position in the terminal equipment during (1) initial tuning of the receiver to a signal, (2) idle test and nonscheduled periods of traffic. It is desired to maintain the equipment in a ready condition, it will be necessary to attend and monitor the receiver-terminal equipment continuously in order to prevent unnecessary wear of the Code Bar.

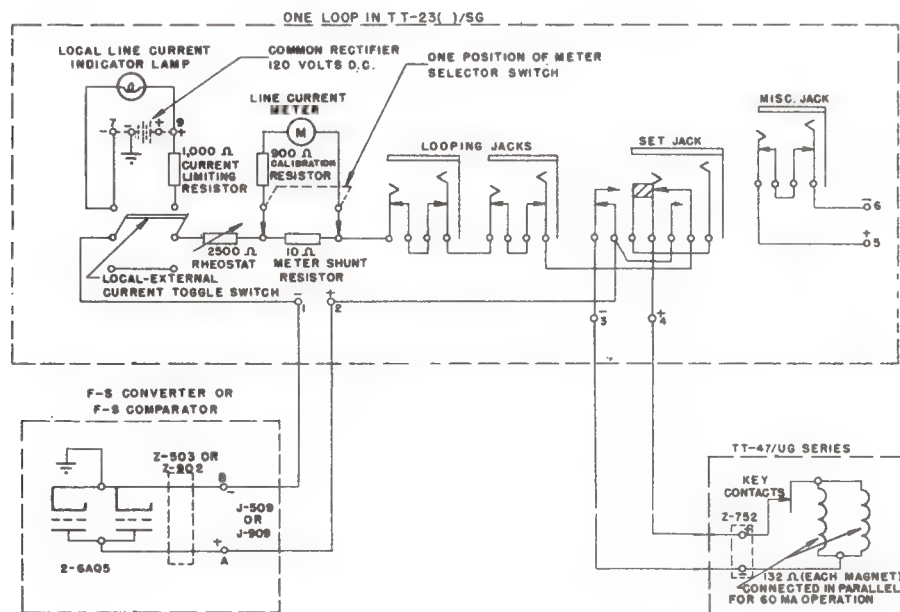
INSPECTION AND ADJUSTMENT OF SHIFT LEVER DRIVE ARM

Inspection by forces afloat of Teletypewriters TT-47/UG; TT-48/UG; TT-69/UG; TT-70/UG reveals binding and wearing of the right and left ends of the common code bar (O-138) at the two points where the bar is in contact with

ORIGINAL



TELETYPE - SEND CIRCUITRY



TELETYPE - RECEIVE CIRCUITRY

the vertical positioning lever toes (parts of 0-1995 and 0-1914).

Distortion of the shift lever bracket (0-2104) occurs in severe cases. After the common code bar has been shifted to the marking condition and is waiting to be brought back to the spacing condition, the shift action occurs before the vertical positioning lever toes have cleared the ends of the common code bar. This condition can be attributed to (1) factory mis-adjustment or (2) slipping of the shift lever drive arm (0-2106) on its smooth shaft (0-2115).

Pending an investigation of these conditions by the manufacturer, all installing activities should completely inspect and adjust, if necessary, the shift lever drive arm on the main shaft at the time of installation in order to insure satisfactory performance of the teletypewriter. (Refer to Instruction Book, NAVSHIPS 91393, Section 7).

TOOL TO HOLD SELECTOR MAGNET ARMATURE IN MARKING POSITION

A tool which will help maintain personnel in making critical adjustments in the Teletypewriter TT-47-48-69-70/UG has been suggested.

This tool facilitates adjustments by holding the selector magnet armature in the "Marking" position, thus allowing all clutches to come to the "Stop" position. These clutches may then be locked and the adjustment made under conditions called for. Both hands are left free to turn the main shaft and to "lock up" the clutches. Each clutch may be locked in turn and no time is lost in having to recycle the mainshaft because one clutch slipped.

Previously, the armature was held by hand, with a screw driver or some other handy tool, which made for inaccuracy and loss of time.

The Bureau is publishing the suggestion so that all vessels and activities which use the TT-47-48-69-70/UG equipment may fabricate and use this tool as a work reducing and time saving device. See Figure 1 for details.

GARBLING

It has been reported that a Teletypewriter TT-69A/UG produced garbled typing after approximately 300 hours of operation. Garbling continued to a lesser degree as the range finder was set toward or near its upper limit. Further observation revealed that a definite pattern of garble was caused by the selector mechanism not responding to some marking impulses. This resulted in the typing of an erroneous character.

An investigation revealed that the start arm was not always being lifted clear of the selector armature, thus preventing the armature from acting freely on a marking impulse.

When the selector clutch assembly and cam shaft were removed, it was noted that the selector stop arm cam (0-1792) and its associated stop arm bail (0-1496) were badly worn. (The stop arm bail, riding on its cam, normally

ORIGINAL TOOL MADE FROM A PIECE OF ALUMINUM 4" LG. X 3/8" WD. X 1/32" THK.

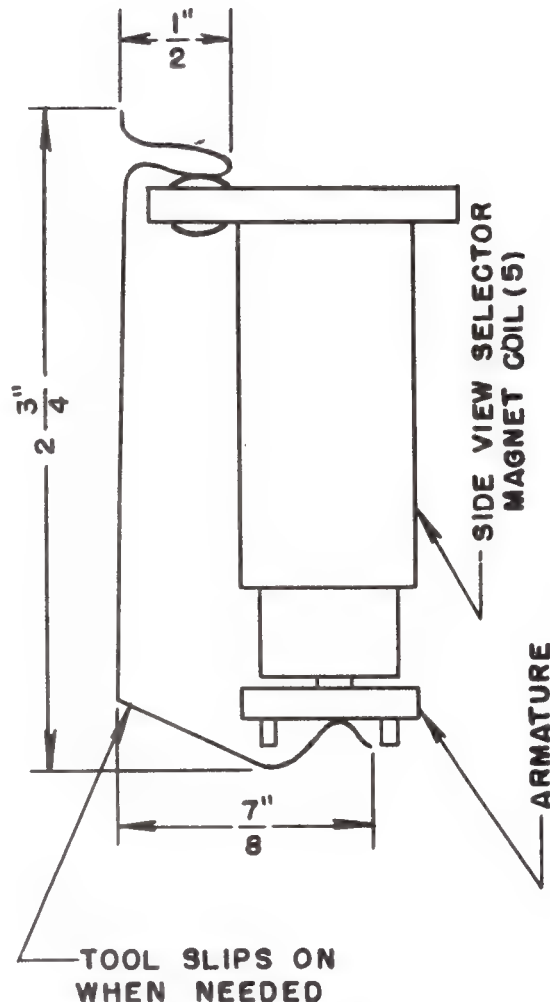


FIGURE 1.--Armature Holding Tool

lifts the start arm clear of the selector armature). Surfaces of the selector stop arm cam and the stop bail cam were worn to .002 and .008 inches respectively.

Various settings of the range finder appeared to give better typing results only because of this imperfect curvature in the worn surface of the stop arm bail. The entire selector cam assembly did not appear sufficiently worn to warrant replacement.

It is recommended, however, that the stop arm bail (0-1496) be replaced in the event that activities encounter this difficulty in the TT-47A/UG, TT-48A/UG, TT-69A/UG or TT-70A/UG.

TELETYPEWRITER MAINTENANCE

This material was included in a beneficial suggestion which proposed that the additional trouble shooting data be published for activities involved with the operation and maintenance of teletypewriter equipment.

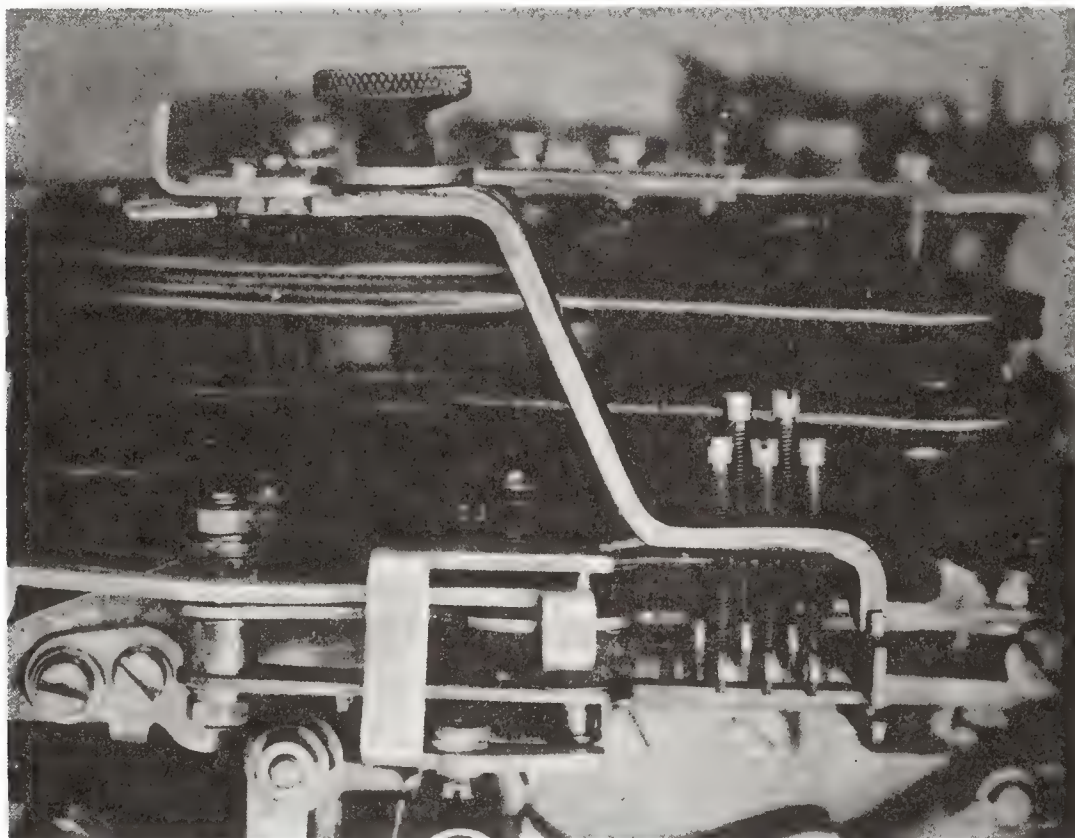
This article includes only a portion of the data submitted.

Figures 2 and 4 contain copy samples with errors. Figures 3, 5 and 6 cover typical troubles and their cure, with reference to the copy sample involved.

In addition to the trouble shooting tables and data, details for a code positioning device have been included.

The codepositioner provides a means for setting up any character or function while trouble shooting the automatic typer. It is mounted between the front plate and the code bar shift bar guide on the automatic typer by a thumb-screw clamp. The five adjustable screws should be aligned with the five code bar shift bars. Any code combination may be obtained by the use of the adjustable screws.

The mark condition of a code bar shift bar is obtained by advancing its associated adjustable screw. The space condition is obtained by retracting the screw. The main shaft is then rotated by hand and the whole sequence of operation can be followed visually. Photo showing Code Positioner in working position on teletypewriter. (See Figure 7 for construction details)



1 THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DTS SENDING
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DTS SENDING

THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DT
2 SENDING
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DT
SENDING

3 THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DTS
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DTS

THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DTS SENDING
4
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DTS SENDING

5 THE QUICK BROWN FOX JUMPED OVER A LAZY DOG J S BACK QWERTYUIOP DTS SENDING
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG J S BACK QWERTYUIOP DTS SENDING

6 THE QUICK BROWN FOX JUMPED OVER A LAZY DOG' B
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG' B K

7 THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DTS SENDING
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DTS SENDING
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DTS SENDING

8 THZ QQPCK BROWN FOX JUMPZD OVER A LAZYHDOG'S BACK 12"4561090 DTS SENDING
THZ QQPCK BROWN FOX JUMPZDHOVERHW LAZYHDOG'S BACK 12"4561090 DTS SENDPNG

9 THE QUICK BROWN FO JUM D OV R LAZY DOG'S BACK 1234567890 DTS SENDING
THE QUICK BROWN FOX J M D OVER AZY DOG' BACK 1234567890 DTS SENDING

10 THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK1234567890 DTS SENDING
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK1234567890 DTS SENDING

11 THE QUICK BROWN FOX JUMPED OVER A LAZY DOGJS BACK QWERTYUIOP DTS SENDING
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG' S BACK 1 2 3 4 5 6 7 8 9 0 DTS SENDING

12 5 3 178:(? 492 , 19/ '7. 03\$ 9;34 -) - "6 \$9&' ? - : (1234567890 \$5 3 , \$8 , &
5 3 178:(? 492 , 19/ '7. 03\$ 9;34 -) - "6 \$9&' ? - : (1234567890 \$5 3 , \$8 , &

13 HHS QUICK ZROWN FMX KUMPSD MYSR U PAZY FOG'S XACK 12345678. 0 FTS SSNFINV
HHS QUICK ZROWN FMX KUMPSD MVSC U PAZY FOG'S XACK 11345678. 0 FHS SSNFINV

14

Copy Samples with errors

T R O U B L E	R E M E D Y	REFERENCE NAVSHIPS		COPY SAMPLE #
		91393	91713	
First two characters on a line not spaced correctly	Spacing drum-stop arm adjustment. Spacing gears out of phase	7-67 7-57	7-75 7-57	1
Automatic carriage return and line feed mechanism operating too soon.	Automatic carriage and line feed adjustment.	7-86	7-89	2
Message overprints on right side.	Spacing cutout lever adjustment.	7-74	7-76	3
Extra space between lines.	Refine automatic carriage return and line feed adjustment.	7-86	7-89	4
More than one function not operating properly.	Function reset bail extension arm adjustment. Function reset bail blade adjustment	7-63	7-65 7-65	5
Right side of line does not print.	Printing track adjustment.	7-77	7-79	6
Paper spindle too tight in bakelite guide blocks.	File end of spindle until a small amount of end play is evident when spindle is in its bakelite guide blocks.			7
Gains and loses fifth pulse.	Left decelerating slide spring broken or missing.	7-74	7-76	8
Misses several characters.	Horizontal positioning lock lever adjustment.	7-59	7-59	9
Incorrect spacing after figures shift.	Shift linkage adjustment.	7-76	7-78	10
Intermittent errors when shifting.	Slide plates adjustment.	7-81	7-64	11
Type box will not shift to letters position.	Shift lever link adjustment. Letters function pawl broken or inoperative. (Emergency repairs can be made by using unshift on space function pawl.)	7-47	7-46	12
Picks up third pulse.	Shift lever link adjustment.	7-47	7-46	13
Message piles up on left side.	Spacing cam plate adjustment. Function pawl stripper adjustment.	7-62 7-84	7-63 7-86	14

B

R

15 O

W

N

- 16 THE QUICK BROWN FOX JUMPED OVER A LAZY DOG JS BACK QWERTYUIOP DTS SENDING
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG JS BACK QWERTYUIOP DTS SENDING

- 17 (Copy transmitted) 12345 6789 12345 YUIO
12345 6789 12345 YUIO (Copy received)
12345 6789 12345 YUIO

- 18 THE QUICK BROWN FOX JUMPED OVER A ~~Z~~X DOG'S BACK 1234567890 DTS SENDING
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 DTS SENDING

- 19 THZ QUICK BROWN FOX JUMPZD OVZR A LWZY DOG'S BWCK 12"4567890 DTS SENDING
THZ QUICK BROWN FOX JUMPZD OVZR A LWZY DOG'S BWCK 12"4567890 DTS SENDING

- 20 THEZQUICKQB~~R~~RGWNHFXFXJUMPI~~B~~ VCZGAWL~~RZ~~ESDBG;S B~~A~~CKQ12345678908D~~B~~S SEND~~NH~~;
THEZQUICKQB~~R~~RGWNHFXFXJUMPI~~B~~ VCZGAWL~~RZ~~ESDBG;S B~~A~~CKQ12345678908D~~B~~S SEND~~NH~~;

- 21 OME QUICK BRO N FOX JUMVED OVER A LAZY DOG'S BACK 3456789; DTS SENDING
OME QUICK BRO N FOX JUMVED OVER A LAZY DOG'S BACK 3456789; DTS SENDING

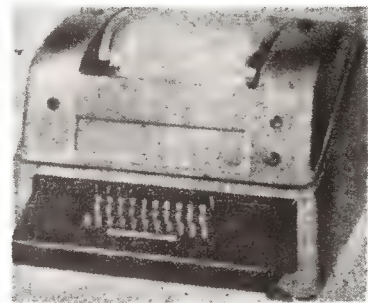
- 22 THZHQQPCKHBROWNHFOXHJQMPZDHOVZRHWWHLWZYHDOG'YHBWCKH12"4561090HDTYHYZNDPNG
THZHQQPCKHBROWNHFOXHJQMPZDHOVZRHWWHLWZYHDOG'YHBWCKH12"4561090HDTYHYZNDPNG

- 23 OHE QUICK BGOWN FOX JUMPED OVER A LAZY DOG S BACK 1234567890 DTS SENDING
OHE QUICK BGOWN FOX JUMPED OVER A LAZY DOG S BACK 1234567890 DTS SENDING

Copy Samples with errors



TT-47/UG
TT-48/UG



TT-69/UG
TT-70/UG

SERVICE NOTES

NAVSHIPS 900,000.1

COMMUNICATIONS

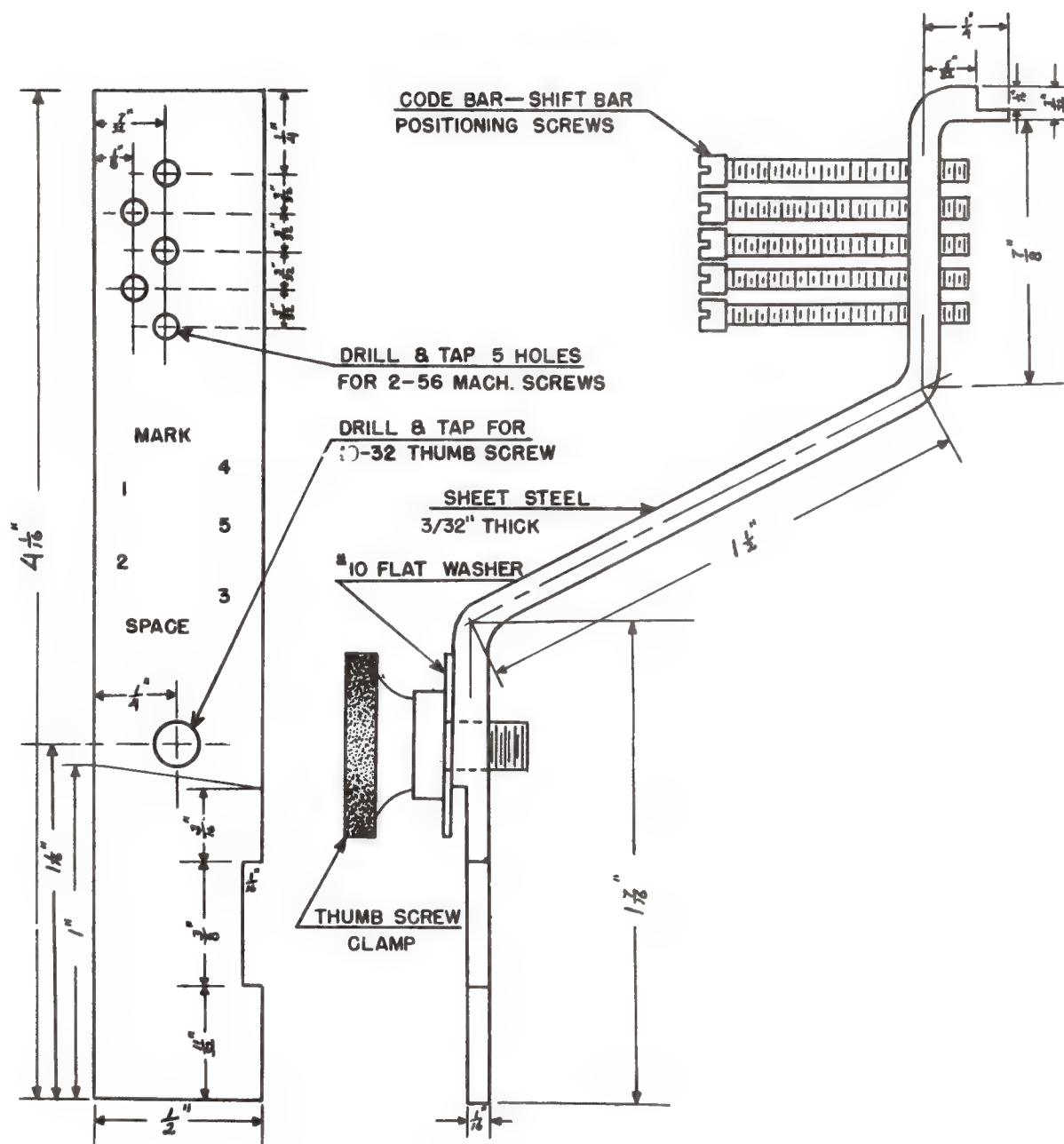
T R O U B L E	R E M E D Y	REFERENCE NAVSHIPS		COPY SAMPLE #
		91393	91713	
Copy appears as illustrated.	Automatic Carriage Return and Line Feed Bell Crank not engaged properly with code bar extension. This can happen when front plate is replaced	2-36	2-37	15
Type box will not shift to figures position.	Figures function pawl broken or inoperative.	7-82	7-84	16
Copy appears as illustrated.	Unshift on space function not disabled.	7-90	7-93	17
Irregular spacing and overprinting.	Spacing feed pawl spring broken or missing.	7-67	7-62	18
Picks up fifth pulse.	Shift slide drive mechanism adjustment.	7-65	7-68	
	Right decelerating slide spring broken or missing.	7-74	7-76	19
Printing carriage incorrectly positioned.	Printing carriage position adjustment.	7-75	7-77	20
Copy appears as illustrated.	Horizontal motion stop slide springs broken or missing.			
	(Top group-Upper slide spring)			21
	(Middle group-Common slide spring)			22
	(Bottom group-Lower slide spring)	2-23	2-24	23
Keytop will not return to upward position after operation under power and printer will keep repeating selected keytop.	Non-repeat lever adjustment.	7-22	7-23	
	Code bar reset bail adjusting screw adjustment.	7-20		
	Code bar bail adjusting screw adjustment.		7-21	
Keytop will not return to upward position after operation under power.	Keytop guide not positioned correctly. (Keytops rubbing on keytop guide hole). Code lever bail latch lever eccentric adjustment.	27(T-2)	7-25	
	Keylever lock ball track adjustment.	7-27	7-29	
	Code bar bail bumper adjustment.	7-24	7-26	

ORIGINAL

TT-47/UG:9

T R O U B L E	R E M E D Y	REFERENCE		COPY SAMPLE #
		NAVSHIPS 91393	91713	
Space bar will not return to upward position, all other keytops do.	Broken lever			
	Symbol # 0-234	7-106		
	Symbol # 0-293		7-108	
	Space bar pivot adjustment	7-24	7-26	
Time Delay Mechanism Attempts to stop motor while copy is being received	Adjust	7-29	7-31	
		7-36	7-35	
	Add clearance between start magnet core and anti-freeze rivet on start armature.	7-96	7-97	
Two teletypewriters operate satisfactorily on separate loops but not together on the same loop.	Refine Selector Armature Spring Tension.			
Errors received that can not be eliminated by refining tuning of associated radio equipment and signal sounds normal.	Patch another teletypewriter into signal loop and take first unit out of loop. If trouble still exists, most likely it is caused by associated equipment. If trouble has disappeared, original teletypewriter is faulty, most likely in automatic typer:			
Ribbon does not feed properly after all adjustments and parts have been checked and re-checked. (applies to TT-47/UG, TT-48/UG, TT-69/UG, and TT-70/UG only)**	Most common trouble has been found to be too much tension on the right ribbon spool shaft spring. This has been corrected by reducing tension of spring Symbol #0-1404 (located under ribbon spool) by cutting off 1/2 turn at a time and re-checking ribbon feed operation each time.			

**The TT-47A/UG, TT-48A/UG, etc., teletypewriters have a different ribbon feed mechanism. No repetitious troubles with this mechanism have been noticed.



TELETYPEWRITER (Part 2) MAINTENANCE**TT-47()/UG, TT-48()/UG****TT-69()/UG, TT-70()/UG**

The previous article carries some trouble shooting data in a unique form. The originator of the material also included point-to-point checks to aid trouble isolation and assure proper operation. The point-to-point checks are presented in this second and final installment.

You can readily see that the form used lends itself to additional steps and procedures which may evolve through use of this material. If you find yourself adding a bit here and there, pass the information along and we'll try to publish revised tables from time to time so everybody can benefit.

S E L E C T O R U N I T C H E C K

Procedure	Observation	Instructions
Patch teletypewriter into a steady 60 M.A. supply at the TT-23/30 panel.		
Alternately type "R" and "Y" and move selector unit range scale arm up toward 100 until copy errors occur in copy.	Note the highest reading obtained with no errors in copy.	
Move the selector unit range scale arm down away from 100 until errors again occur in copy.	Note the lowest reading obtained with no errors in copy.	
	For the TT-47/UG, -48/UG, -69/UG and -70/UG, the high reading should be between 90 and 100 and the low reading should be between 30 and 40. When the lower reading is	If reading is okay, set the selector unit range scale arm between 75 to 80. (This is the setting usually found to be correct after check-

CUT TO - 11 CIRCLES FULL WIDTH

Procedure	Observation	Instruction
	subtracted from the higher reading, the result should be 60 points or more.	teletypewriter on a bias test set.
	For TT-47A/UG, -48A/UG, -69A/UG -70A/UG, the high reading should be between 110 to 120 and the low reading should be between 30 and 40. When the lower reading is subtracted from the higher reading, the result should be 70 points or more.	If reading is okay, set the selector unit range finder knob between 70 to 75. (This is the setting usually found to be correct after checking the teletypewriter on a bias test set.
Check selector unit adjustments.		If reading is not right go to next step
Check assemblies between check point #2 and check point #3 (see Block Diagram).		If trouble not found go to next step.
		If trouble corrected go to Check Point #3 procedure.

CHECK POINT ONE

Procedure	Observation	Instructions
Power off, select letter "R".	Observe the right hand end of code bars. Code bars #2 and #4 should move to right or mark position, #1, #3 and #5 should stay at left or space position.	If correct action takes place do next step, if not, go to step 3.
Rotate motor by hand until signal generator clutch is disengaged. Select letter "Y".	Code bars #1, #3 and #5 should move to right, #2 and #4 should stay at left.	If operation is satisfactory go to Check Point #2 procedure.
Make visual check of code bars and springs.		If operation is unsatisfactory go to next step.
Remove automatic typer, rotate keyboard signal generator shaft by hand until signal generator clutch is disengaged, select any character or function.	The selected signal code (see page 2-1 NAVSHIPS 91393 and page 2-3 NAVSHIPS 91713) calls for a code bar to go to the right or marking position and it does not operate.	If trouble not found go to next step.
		Check for missing springs or binds in code levers, code bars or keyboard lock bar. Refer to Theory of Operation of the instruction books.

A common cause of intermittent trouble at this check point can be found in the following manner. Rotate the signal generator shaft until the signal generator clutch is disengaged and select "R".

Code bar #2 and #4 go to right.

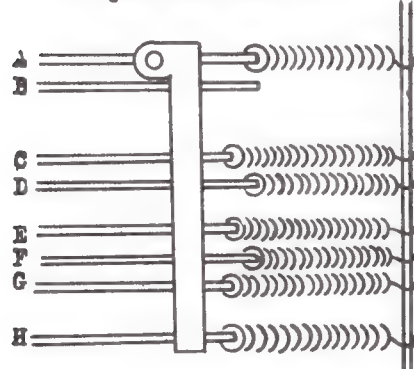
Next step.

Now tap keylever "R" a few times while it is in its downward position.

See if code bars #1, #3 or #5 slip to right.

Next step.

Repeat check with letter "Y".
KEYBOARD CODE BARS
(right hand side)



Observe if any code bar slips to the right when the teletypewriter signal code does not call for a mark pulse.

Check the code lever bail latch lever adjustment, Page 37 of T-2 to NAVSHIPS 91393 and Page 7-25 NAVSHIPS 91713.

A. CLUTCH TRIP BAR
B. UPSTOP

C. No.1 CODE BAR
D. No.2 CODE BAR

E. No.3 CODE BAR
F. No.4 CODE BAR
G. No.5 CODE BAR

H. KEYBOARD LOCK BAR

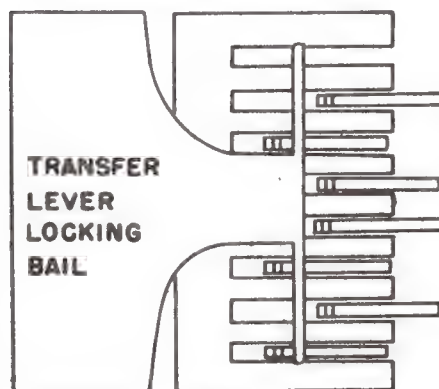
Code bars positioned as at left when letter "R" keylever is depressed.

MARK

SPACE

KEYBOARD TRANSFER LEVERS

(as viewed from top)

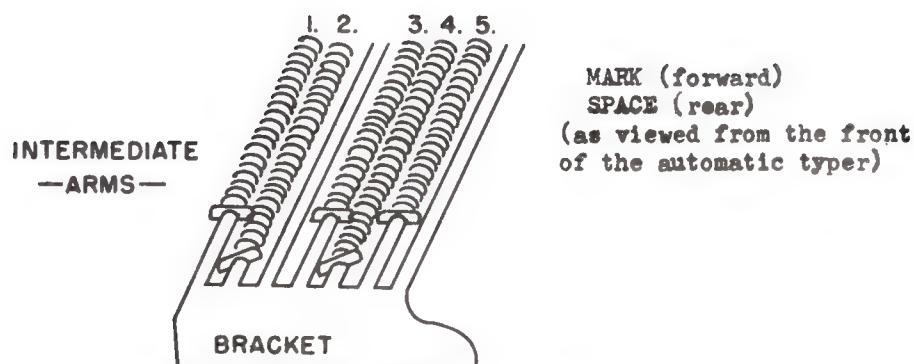


No.1 TRANSFER LEVER
No.2 TRANSFER LEVER
STOP (Permanent Right)
No.3 TRANSFER LEVER
No.4 TRANSFER LEVER
No.5 TRANSFER LEVER
START (Permanent Left)

MARK

SPACE

TRANSFER LEVERS POSITIONED AS ABOVE WHEN LETTER "R" KEY LETTER IS DEPRESSED



INTERMEDIATE ARMS POSITIONED AS SHOWN ABOVE WHEN LETTER "R" IS SELECTED (as viewed from the right side of the automatic typer)

C H E C K P O I N T T W O

Procedure	Observation	Instructions
Power off, select letter "R".	Observe upper end of transfer levers. Upper end of transfer levers #2 and #4 should move to left, #1, #3 and #5 should stay at right.	If correct action takes place, do next step, if not go to step 3.
Rotate motor by hand until signal generator clutch is disengaged. Select letter "Y".	Upper end of transfer levers #1, #3 and #5 should move to left, #2 and #4 should stay at right.	If operation is satisfactory go to Check Point #3 procedure. If operation is not satisfactory and Check Point #1 is satisfactory, go to next step.
Check signal generator mechanism.		If trouble not found go to next step.
Check locking bail spring tension.	A common cause of intermittent trouble at this check point was found to be an insufficient amount of tension on the locking bail spring.	Turn power on, apply pressure downward on the transfer lever locking bail with one finger, type with other hand. If errors stop, increase tension on locking lever bail spring.

CHECK POINT-THREE

Power on, type letter "R".

Observe intermediate arms and associated springs. Intermediate arms #2 and #4 should be forward in a mark position, #1, #3 and #5 should be toward the rear in a space position.

type letter "Y".

The opposite conditions exist from those above.

Repeat step 1 test by alternately typing "R" and "Y".

Watch for any intermittent operation of intermediate arms.

If intermediate arms operate correctly, go to Check Point #4 procedure. If intermediate arms not operating correctly and Check Point #2 is okay, go to next step.

Check assemblies between Check Point #2 and Check Point #3 (see Block Diagram).

When trouble corrected, go to Check Point #4 procedure.

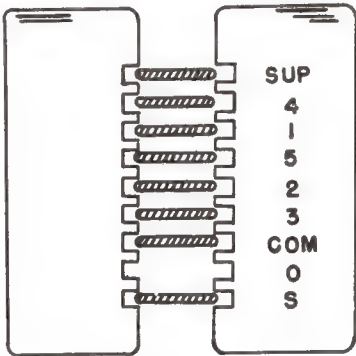
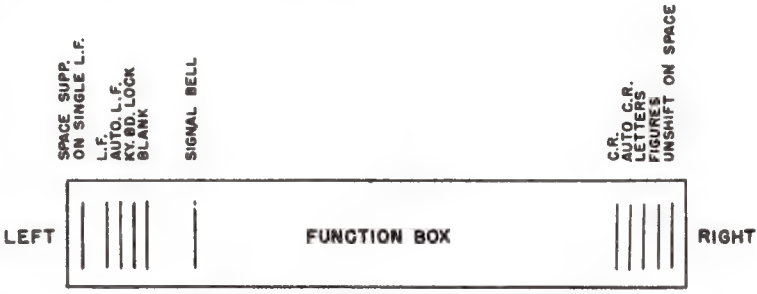


TT-47/UG
TT-48/UG



TT-69/UG
TT-70/UG

CHECK POINT FOUR

Procedure	Observation	Instructions
Power on, type any character.	The code bars should be in the left position for a mark pulse and the right for a space pulse.	
type letter "R".	Code bars #2 and #4 should go to left, #1, #3 and #5 should go to right.	
type letter "Y".	Condition of Code bars are opposite from above (for R).	
Repeat above, alternately typing "R" and "Y".	Watch for any intermittent operation of code bars.	If Code bars do not set up right, check assemblies between Check Point #3 and Check Point #4 (see Block Diagram). If code bars set up okay and trouble is a function error, go to next step. If code bars set up okay and trouble is a printing error, go to step 5.
AUTOMATIC TYPER CODE BARS MARK (left)--SPACE (right) (as viewed from front of automatic typer)		
Function Error: Turn motor off, remove automatic typer, and lift roll of paper out of typer so that function box can be observed. Set up function desired by using Teletypewriter Code Positioner (described elsewhere) or by pushing transfer levers or code bar shift bars to the rear when the teletypewriter signal code calls for a mark pulse; ie; to check line feed, hold #3 transfer lever or #2 code bar shift bar to a rear position. Rotate main shaft by hand.		
		
		
Repeat Function Error test above as necessary.	Observe action of function bar, function pawl, and function lever of suspected function.	If trouble is not apparent check Instruction Book 'theory of operation of the function causing trouble.

Procedure

Observation

Instruction

Printing Error:

Set up code bars by using the Teletypewriter Code Positioner (described elsewhere) or by pushing transfer levers or code bar shift bars to the rear when the teletypewriter signal code calls for a mark pulse; ie; to check "R", hold #2 and #4 transfer lever or #2 and #4 code bar shift bar to a rear position. Retate main shaft by hand.

Observe horizontal and vertical positioning mechanism.

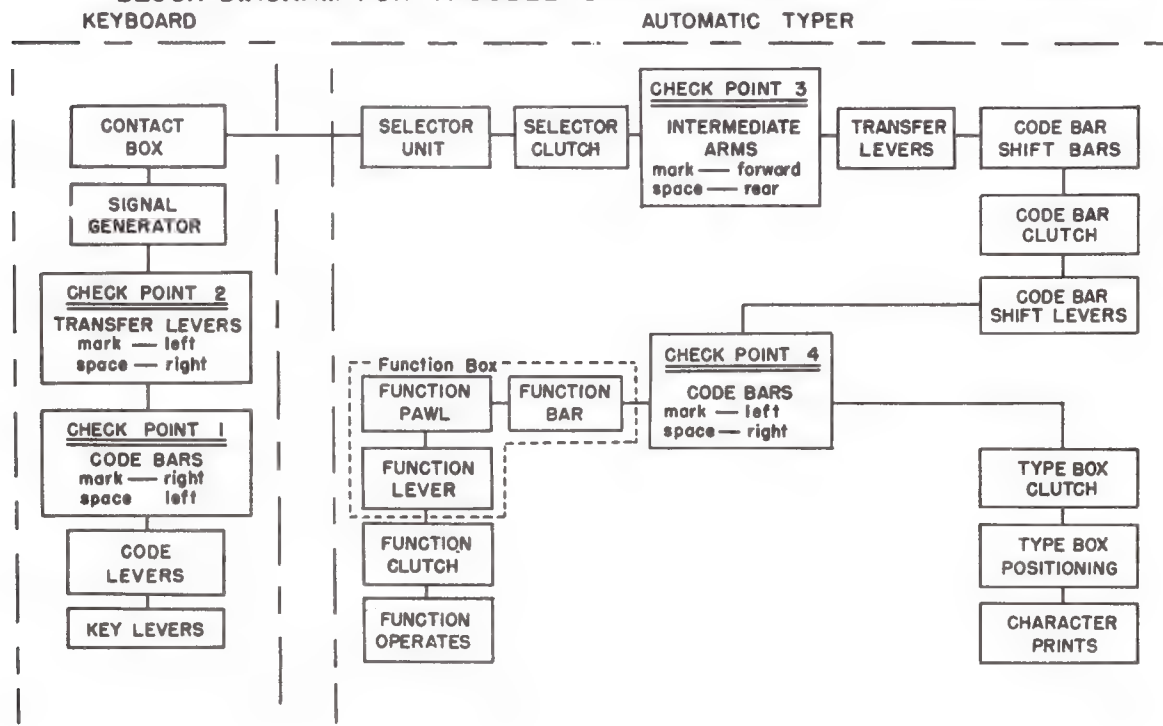
If trouble is not apparent, check Instruction Book 'theory of operation' of vertical and horizontal positioning mechanism.

Errors received that can not be eliminated by refining tuning of associated radio equipment and signal sounds normal.

If function trouble is indicated, start at check point #4. If intermittent or garble perform Selector Unit Check.

Errors appear in copy while typing at local keyboard.

Refer to check point #1 procedure.

BLOCK DIAGRAM FOR TROUBLE SHOOTING MOD. 28 TELETYPEWRITER

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****TT-50/UG COPYHOLDER**

It has been pointed out in a beneficial suggestion that all TT-50/UG equipments do not have copyholders.

A copyholder was originally packed with each TT-50/UG for installation by the using activity. However, some of the

teletypewriter were used to receive only; therefore, the copyholder may never have been installed, and subsequently misplaced.

When the TT-50/UG is used to transmit messages, a copyholder should be used. Copyholder assemblies may be requisitioned by (SNSN N17-T-350012-934).

TT-71/UG CARE OF PROJECTOR SCREEN

Recent increased demands for the projector screen part number 96864, SNSN N17-T-350003-518, of Teletype equipment TT-71/UG make it imperative that care be given to this part in an effort to make it last longer, and reduce requirements.

Basic instructions for the care of the projector screen are included in the equipment instruction book and are repeated here with some added information for interested personnel.

Instructions for Installation* and Care of the Projector Screen - Remove the screen frame from the front of the upper section and install the 96864 projector screen. To do this, unroll the screen and place it over the opening in the upper section of the cabinet. Begin lacing by carrying the cord from the center eyelets on the upper and lower edges of the screen, over corresponding center studs on the cabinet.

Lace from these centers toward each end and tie the ends of the lacing cord securely. CAUTION: Under no circumstances should the screen be folded, creased, or handled carelessly.

If a screen has been shrunk or wrinkled in storage, special care should be exercised when mounting it on the cabinet. The lacing should be tightened gradually over a period of several days in order to restore the screen to its original shape and size without damaging it.

The crystalline surface of the screen should be cleaned when necessary by a dry process, using a clean brush, not too harsh. The non-crystalline side of the screen, which should always face toward the projector, may be cleaned with either a brush or a soft cloth. If this method is not sufficient, a clean soft cloth dampened with wood alcohol or grain alcohol may be used.

* An improved method of lacing the screens on the projector is discussed in EIB 392. This lacing method will do much to prolong the screen's life.

ALIGNMENT AND MAINTENANCE

Many Link (11UF-12UF) FM receivers in the field have been found to be improperly tuned, thus losing many of the advantages of FM reception and greatly reducing the range.

A method of alignment which has proven itself in practice will be outlined in "step by step" progression. No signal source other than an FM transmitter is necessary. The instruments and tools needed are as follows:

- 1--0-1 d-c milliammeter.
- 2--0-100 d-c voltmeter.
- 3--50-0-50 d-c galvanometer or microammeter.
- 4--Non-metallic "screwdriver" (this may be a neutralizing tool).

Two types of instruments incorporating the above meters, mounted in a small portable oak case are available. They are Link Type 1288 and 1617. (They may also be used for the transmitter adjustment and Type 1617 includes a wave-meter.)

The following tuning procedure is recommended:

- 1--Allow a 15-minute "warm up" period.
- 2--Using the 0-100 d-c voltmeter as an indicator, carefully adjust the oscillator trimmer T9 to maximum voltage, by taking a reading between the condenser shaft and ground. This should be about 60-80 volts. No signal is necessary for the adjustment. This completes oscillator tuning.
- 3--Plug the 0-1 milliammeter into jack T5A (J1 in mobile receiver) which is first limiter grid. Use a fairly strong signal of the exact frequency and tune T1 (antenna trimmer), T2 (r-f stage), T3B, T4B and T5A for maximum reading of the 0-1 milliammeter.
- 4--Plug 0-1 milliammeter into jack T6A (J2) which is second limiter grid and tune T6A for maximum reading using fairly strong signal.
- 5--No signal used. Visually set the primary trimmer of T7 (discriminator) so that the factory painted red lines coincide. The primary trimmer is the one nearest the 6AC7 tube. Should the red line be missing, set the trimmer midway in its travel as any misadjustment of the primary may be compensated for by the secondary tuning. This completes the primary tuning of the discriminator.
- 6--Use a fairly strong input signal. Plug the galvanometer into "Balance" jack. Tune the secondary trimmer of T7 so that the galvanometer reads "zero". This may be checked by cutting off the input signal in which case the meter will read several divisions off "zero". The meter should return to "zero" when the same input signal is reapplied. The tuning of the discriminator (T7) is now complete and no further adjustments need be made.
- 7--To obtain the utmost in performance it is necessary to realign T1, T2, T3B, T4B and T5A using a

very weak input signal. Plug the "zero center" galvanometer into T5A (J1) and tune all these carefully maximum deviation.

8--Still using a very weak signal plug the 0-1 milliammeter into jack T6A (J2) and tune for maximum deflection. Sometimes the added sensitivity of the galvanometer may be taken advantage of in this jack but unless the signal is very weak it will go "off scale".

9--Setting the squelch is the final adjustment. It is plainly marked "squelch" and is located directly below T10. The proper adjustment is slightly beyond the point at which the rushing noise stops, and it must be adjusted without any input signal. The receiver is now properly tuned.

The equipment should be retuned at weekly intervals for a month until it has heat cycled and settled down. Thereafter semimonthly tuning is adequate.

Always have the motor in the vehicle operating at a "fast idle speed when adjusting mobile stations.

Two grounds are advisable in vehicular installations. One should be one-half inch copper braid running from the mobile station ground to the car battery cable ground.

It is advisable to note that T2 and T9 are "calibrated" from one to ten so their approximate frequency can be interpolated from the position of the red line marked on the condenser shaft. This reading (expressed in megacycles) is determined from the second numeral of the frequency. Sample settings are as follows: 36.140 Mc, six; 38.300 Mc, eight; 30.300 Mc, zero; etc.

Should a signal generator be used for alignment, let it warm up for an hour and zero beat it frequently against a signal of the known proper frequency.

In addition to the usual test of tubes in a tube checker try them in an equipment which is known to be operating correctly and discard any which prove defective. This is of paramount importance.

Other things being equal, antenna height is the deciding factor in 30-40 Mc communication. Strive for "in the clear" antenna locations in both fixed and mobile stations. It is always well to locate the fixed station antenna in a high electrically quiet location and remote control the station itself.

Remote controls require an a-c source (60 watts at 110 volts) and a telephone pair. They will operate the fixed station at distances up to twelve miles. Any number can be used and they furnish complete operation (transmitting and receiving) and occupy much less space than the fixed station.

Motor (or other) noise should be eliminated exactly as if an AM installation were to be made. A test may be made by using so weak a signal that it will only partially quiet the receiver and then listening with and without the noise. The ideal, of course, is to be able to detect no difference.

TYPE NUMBER 23211 TROUBLE SHOOTING NOTES

Difficulty Encountered

Type 23211-A Equipment. --Remote radiophone unit failed to operate from any transmitter. Relay K-201 vibrated as if actuated by a-c current.

Type 23211 Radiophone Unit. --Mounting screw for relay K-201 vibrated loose due to gun fire.

Cause and Remedy

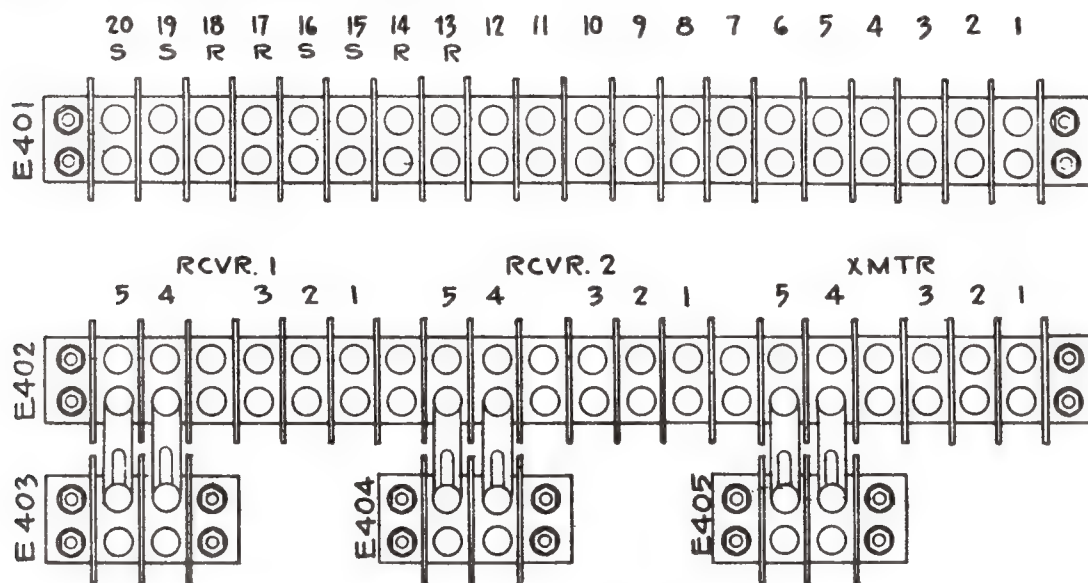
Trouble caused by four wires becoming disconnected from terminal #6 on type RN-23206 radiophone transfer panel, due to poor soldering job. Normal operations restored by resoldering wires to terminal lug.

Removed original screws and replaced with screw 1/8" longer to permit peening the thread on the end above the securing base. Original screws loosened in spite of tight screws and locked washers. By peening the ends, absolutely prevented loosening of the relay.

TERMINAL STRIP MARKINGS

The Bureau has recently received information that several Remote-Control Indicator Units Type-23496 were found to have no identification markings for the terminal

strips mounted in the back of the cabinets. For the convenience of those installing activities finding this condition, the accompanying diagram is published. Additional copies are available from the Bureau of Ships.



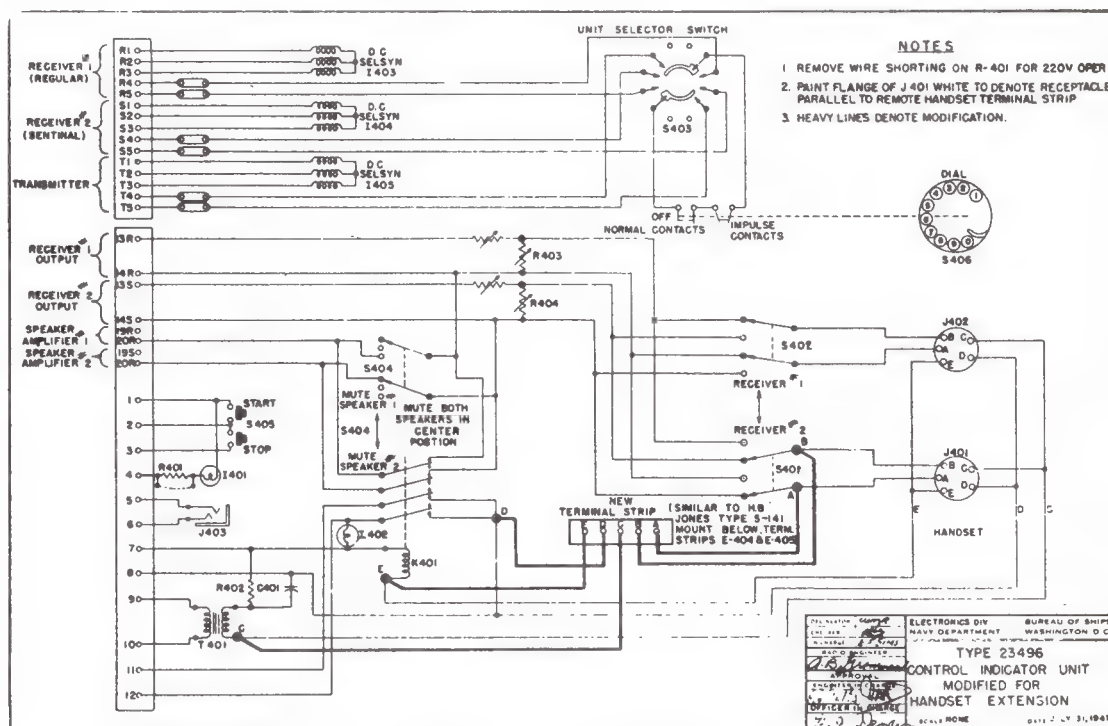
View of Terminal Strips from Front of Cabinet

FIGURE 1.--Terminal strip markings on type CQC-23496 remote control indicator unit

TYPE-23496 MODIFIED FOR HANDSET EXTENSION

To fulfill the need in some ships for an extension handset for A Remote-Control Indicator Unit Type 23496, a method has been devised to connect a terminal strip in parallel to one of the handset receptacles. Because of difficulty in connecting additional conductors to the receptacle lugs, other solder points were found which

facilitate wiring. The back of these points is indicated in Figure 1 by a circle and designated by a letter which corresponds to the pin designation in the handset jack. The wiring to the new terminal strip is drawn in heavy lines. Inasmuch as there are two handset receptacles in the -23496, the Bureau desires that the flange of receptacle J-401, to which the new terminal strip is set parallel, be painted white.



SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****NT-23497 SELECTOR CONTROL UNIT ELIMINATION OF DUMMY PLUG**

The Mare Island Naval Shipyard has suggested eliminating the requirement for a dummy plug in Selector Control Unit NT-23497. The audio output of the receiver in TDZ/RDZ installations is only available at terminals 9 and 11 on terminal strip E-101 of the Selector Control Unit when a dummy plug, jumpered from A to J and L to K, is plugged into J-102. The removal or loss of this plug opens the audio circuit to the terminal strip. The electrical equivalent of the plug can be obtained as follows: Remove the filter-assembly cover in the unit and solder a jumper to the terminal post common to L-101 and C-117 (network is at left

end of filter bank, as viewed from front). Solder the other end of this jumper to terminal No. 11 on terminal strip E-101. Connect a second jumper between terminal No. 9 of the terminal strip and the terminal post common to L-102 and C-118. Figure 7-3 in NAVSHIPS 900,777 will aid in locating the points where the above connections are made. If available, cap and chain assembly SNSN N17-G-200911-0524 should be installed on J-102. No field change will be initiated for this modification.

TYPE 49131 SERIES SPEAKER-AMPLIFIER UNITS

The Bureau has received numerous requests from installation and maintenance yards for technical manuals or data sheets covering the type 49131 series speaker-amplifier units. Such information was not obtained with these units and is therefore not available for distribution.

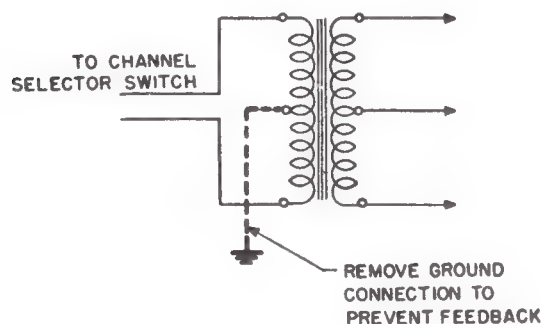
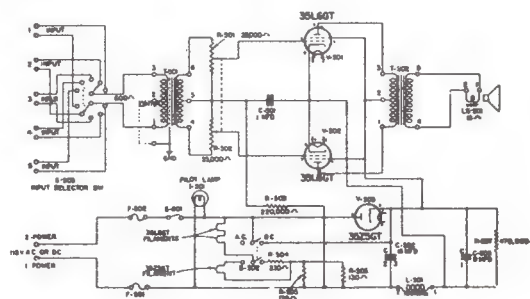


FIGURE 1.--The center-tap lead on the primary of input transformer should be removed

A wiring diagram and parts list is secured inside the cabinet of each speaker-amplifier. However, the examination of this diagram and parts list is usually not very convenient after the unit has been installed and it is believed desirable to reproduce the applicable lists and diagrams herein for ready reference.



Parts List for Type 49131 Speaker-Amplifier Unit--Continued

Schematic symbol	Description	Navy type No.	RCA Manufacturing Co., Inc., part No.	Quantities of spare parts furnished
T501	Transformer, audio input, center-tapped primary and secondary. D.-c. resistance of primary (between terminals 1 and 3) 26 ohms; d.-c. resistance of secondary (between terminals 4 and 6) 2000 ohms.	CRV-30765	K-901022-501	
T502	Transformer, audio output, center-tapped primary. D.-c. resistance of primary (between terminals 1 and 3) 104 ohms; d.-c. resistance of secondary (between terminals 4 and 5) 0.57 ohms.	CRV-30766	K-901023-501	
X501	Socket, octal base	CPH-49351	M-421395-506	
X502	Same as X501			
X503	Same as X501			
V501	35L6GT tube			4
V502	Same as V501			
V503	35Z5GT tube		P-712594-504	2
LS501	Loudspeaker cone assembly		P-712678-504	

Parts List for Types 49131A and 49131B Speaker-Amplifier Units

C501	Capacitor, 1-mfd. -3 percent + 10 percent, 400 v. d.-c. working.	-48595-A	P-720555-2	1
C502	Capacitor --consists of 3 sections, each section 8 mfd. -3 percent + 10 percent, 500 v. d.-c. working.		K-90549-1	1
C503	C502 denotes 2 of the sections connected in parallel totaling 16 mfd.; C503 denotes 1 section 8 mfd.			
F501	Fuse, 1 ampere, 250 v., cartridge type		K-55544-14	8
F502	Same as F501			
I501	Pilot light assembly socket, candelabra screw base lamp, candelabra screw--115 v., 0.1 ampere.	CS-5/17	K-857431-1	
	Reflector, red jewel, complete with nut.		K-866645-1	1
			K-99013-1	
L501	Reactor, plate filter, impedance 2000 ohms at 60 cycles.	CRV-30764	K-901021-1	
R501, 502	Potentiometer, dual section, each section 25,000 ohms ±10 percent, wire-wound.		K-858187-1	1
R503	Resistor, 220,000 ohms ±10 percent, 1/2-watt, insulated type.		K-850981-90	1
R504	Resistor, 230 ohms, wire-wound, ferrule type, stype B		M-420664-36	1
R505	Resistor, 130 ohms ±5 percent, 1-watt, insulated type.		K-845949-34	2
R506	Same as R505			
R507	Resistor, 470,000 ohms ±10 percent, 1/2-watt, insulated type.		K-850981-94	1
S501	Switch, s.p.s.t., toggle type	CHH-24000	M-420278-1	
S502	Switch, d.p.d.t., toggle type	CHH-24003	M-420278-4	
S503	Switch		K-180411	
T501	Transformer, audio input, center-tapped primary and secondary. D.-c. resistance of primary (between terminals 1 and 3) 26 ohms; d.-c. resistance of secondary (between terminals 4 and 6) 2000 ohms.	CRV-30765	K-901022-501	
T502	Transformer, audio output, center-tapped primary. D.-c. resistance of primary (between terminals 1 and 3) 104 ohms; d.-c. resistance of secondary (between terminals 4 and 5) 0.57 ohms.	CRV-30766	K-901023-501	
X501	Socket, octal base	CPH-49351	M-421395-506	

Parts List for Types 49131A and 49 31B Speaker-Amplifier Units--Continued

Schematic symbol	Description	Navy type No.	RCA Manufacturing Co., Inc., part No.	Quantified of spare parts furnished
X502	Same as X501			
X503	Same as X501			
V501	35L6GT tube			4
V502	Same as V501			
V503	35Z5GT tube		P-712594-504	2
LS501	Loudspeaker cone assembly		R-712678-504	

INSTALLATION OF JUMPERS ACROSS INPUT TERMINAL STRIP

The type 49131 series of speaker-amplifier units, except the basic 49131, contain either 3-channel or 5-channel selector switches. These switches are essential when the speaker-amplifier units are used in conjunction with the standard multi-channel broadcast distribution system but are not required, and are objectionable in certain instances, when these units are used on single communication circuits. Several reports reaching the Bureau indicate that unauthorized personnel frequently operate the switch, either thinking that the unit is connected in the broadcast circuit, or just for their amusement. The switch is sometimes left in an open channel and the speaker fails to function when the communication circuit is energized.

To eliminate the possibility of the above condition, it is recommended that all types 49131 units installed on single communication circuits be modified according to Figure 1. Jumpers are installed across the input terminals as indicated, permitting the speaker to operate regardless of the position of the switch.

FEEDBACK ELIMINATION

Occasionally feedback is present between the 49131 series speaker-amplifier unit and a microphone or handset connected to the same circuit or a radiophone unit. The press-to-talk switch in the microphone or handset operates a relay in the associated 23211 or 23423 radiophone unit. The relay is intended to cut out the speaker, but actually only breaks one side of the line, leaving the speaker not entirely inoperative due to a sneak circuit through ground. The center-tap of the speaker-amplifier input winding is grounded. Therefore, when the receiver connected to the particular radiophone unit has a grounded output, the circuit will be completed through ground and one-half of the input winding. The condition can be eliminated by disconnecting the center-tap lead on the input transformer from ground, as indicated in Figure 1.

It should be noted that this method applies only to the type 49131 series units used on communication circuits. Similar units used on standard broadcast reception systems should not be altered in this manner.

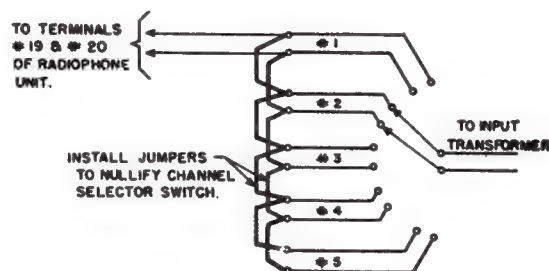


FIGURE 1.--Jumpers installed across input terminals of type 49131 speaker-amplifiers

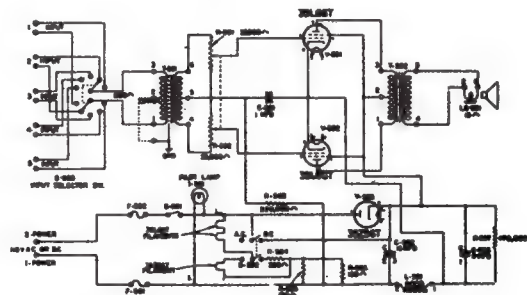


FIGURE 1.--Speaker-amplifier CMX-49131C

POTENTIOMETER FAILURES

Excessive failures of potentiometers R-501 and R-502, have been reported from the field. Investigation discloses that the failures in the large majority of cases are broken stops. This allows the sliding contact to travel farther than it should, causing damages to the winding and also to the coupling link between the sections.

Personnel are cautioned to use these potentiometers with greater care in order that such failures be reduced to a minimum. Every effort should be exerted to inform all hands who have access to the speaker-amplifier that such caution must be practiced. It is suggested that a tag or label be attached to the unit to warn against rough usage.

COMMUNICATIONS

NAVSHIPS

900,000.1

SERVICE NOTES

MODIFICATION OF CHANNEL SELECTOR

When type 49131 speaker-amplifiers for the RBO entertainment system are installed in crew and troop quarters, the channel selector switch takes a terrific amount of abuse due to continual switching in search of programs.

A double-pole double-throw toggle switch in place of the rotary switch has been installed in such units. The toggle switch is entirely satisfactory for a RBO system where only two RBO receivers are used, and the toggle

switch is more sturdy than the rotary switch and better able to stand up under extreme abuse.

This modification is recommended for other ships having two RBO receivers where the channel selector switch has been damaged due to misuse.

The schematic drawing for the Navy type CMX-49131C speaker amplifier unit is pasted inside the case of the equipment. Since this may not be convenient for reference, the drawing and parts list are reproduced herewith as figures 1 and 2.

Schematic symbol	Description	Navy type No.	Magnavoc Co. dwg. and part No.	Quantities of spares furnished
C-501	Capacitor, 1 mfd. $\pm$ 10 percent, 400 v.d.c. working.	C-48595A-10	B-250091	1
C-502	Capacitor, consists of three sections, each section 8 mfd. $\pm$ 20 percent, 500 v.d.c. working	C-481337	B-290008	1
C-503	C-502 denotes two of the sections connected in parallel totalling 16 mfd. C-503 denotes one section 8 mfd.			
F-501	Fuse, 1 ampere, 250 v., cartridge type.		A-180157G6	8
F-502	Same as F-501.			
I-501	Pilot light assembly: Socket, candelabra, screw base. Lamp, candelabra screw, 115 v., 0.1 a. Reflector, red jewel, with nut.	CS-5/17	A-180233 A-180161G2 A-180235G1	1
L-501	Reactor, plate filter, impedance 2000 ohms at 60 cycles.	C-30764	B-350007	
R-501	Potentiometer, dual-section, each section 25,000 ohms $\pm$ 10 percent, wire wound.		A-220040	1
R-502				
R-503	Resistor, 220,000 ohms $\pm$ 10 percent, 1/2 watt insulating type.		B-230063G90	1
R-504	Resistor, 230 ohms, wire wound, ferrule type.		A-240020	1
R-505	Resistor, 130 ohms $\pm$ 10 percent, 1 watt insulated type.		B-230065G257	2
R-506	Same as R-505.			
R-507	Resistor, 470,000 ohms $\pm$ 10 percent, 1/2 watt insulated type.		B-230063G94	1
S-501	Switch, s.p.s.t., toggle type.	C-24000	C-160037G4	
S-502	Switch, d.p.d.t., toggle type.	C-24003	C-160037G5	
S-503	Switch.		A-160064	
T-501	Transformer, audio input, center-tapped primary and secondary, d.c. resistance of primary (between terminals 1 and 3): 26 ohms; d.c. resistance of secondary (between terminals 4 and 6): 2000 ohms.	C-30765	B-320007	
T-502	Transformer, audio output, center-tapped primary, d.c. resistance of primary (between terminals 1 and 3): 104 ohms; d.c. resistance of secondary (between terminal 4 and 5): 0.57 ohms.	C-30766	B-330009	
X-501	Socket, octal base.	C-49351	A-180232	
S-502	Same as X-501.			
X-503	Same as X-501.			
V-501	35L6GT tube.			4
V-502	Same as V-501.			
V-503	35Z5GT tube.			2
L-S501	Loudspeaker. Conehead assembly.		16C10G2 16C11G2	

TYPE NUMBER 49131 TROUBLE SHOOTING NOTES

Difficulty Encountered

Equipment Type 49131.--Speaker-amplifier unit failed due to exposure to the weather, resulting in the volume control potentiometer becoming disabled.

Speaker-Amplifier Type 49131.--Damaged channel selector switch on model 49131 series speaker-amplifiers used with RBO systems.

Speaker-Amplifier Type 49131.--Internal temperature of speaker-amplifier during operation melted solder seal on cap at terminal (lower) end of reactor case, allowing insulating tar to run out, leaving reactor loose in case. In two previous similar instances in other speaker-amplifiers on the ship, the reactor dropped out of the case, breaking the leads and causing failure of the unit.

Speaker-Amplifier Type 49131.--Intermittent operation or dead.

Speaker-Amplifier Type 49131-B.--On a-c power, a loud hum is noticed. No noticeable effect when on d-c.

Speaker-Amplifier Type 49131.--Output very distorted and volume low.

Speaker-Amplifier Type CMX 49131C.--Extreme 60-cycle hum and distortion noted. Normally this would indicate faulty capacitors.

Cause and Remedy

To prevent future failure, a sheet metal hood has been installed over the unit and a canvas cover placed over the unit.

Usually caused by crew members trying to find out what is on the other "censored" channels when the stop is set for 1, 2, or 3 channels as the case may be. After replacing or repairing switch, set the stop so that the knob can be turned to all 5 channels.

As a temporary modification only, to preclude the possibility of this trouble recurring, the reactor was removed and replaced with a 250-ohm 2-watt composition resistor. No noticeable hum in the output with either a-c or d-c power supply. Equipment now operates satisfactorily.

Check power and audio leads between terminal board and front panel. These frequently break or ground to shielding at the hinge joint.

Wiring harness from input transformer to volume control was found to be faulty. At each spot where the individual shielded wires were soldered together, the insulation was damaged by the heat of the soldering iron. Replaced defective wiring.

Found to be due to volume control R-501 and R-502 being damaged by oil leaking from oil filled components. Repaired by cleaning control with carbon tetrachloride and scraping away defective insulation.

This trouble was caused by the dual potentiometer having its shaft broken between the two sections. This caused the lower section, R-501, to remain stationary while the upper section, R-502 rotated. The potentiometer was replaced and the equipment operated normally.

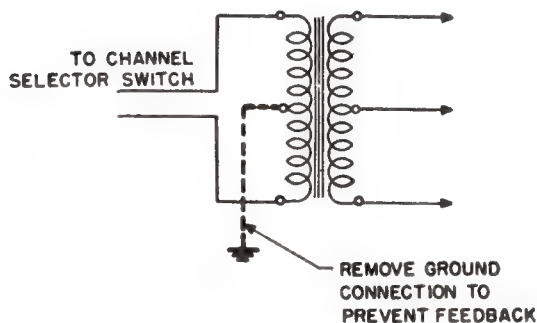


FIGURE 1.--The center-tap lead on the primary of input transformer should be removed

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****NAVY TYPE 49545 SPEAKER-AMPLIFIER POTENTIOMETER FAILURE**

Attention has been directed to a potentiometer failure in the type 49545 (RBO) Speaker-Amplifier. The Bureau of Ships Electronic-Equipment, Failure Tabulation, Summary Report, indicated that potentiometer (R-106) in the type 49545 Speaker-Amplifier becomes defective when exposed to a moist atmosphere. Tests at the Material Laboratory,

New York Naval Shipyard, have substantiated the above report. The following repair should be accomplished at the earliest opportunity by maintenance personnel of the activity or vessel to which the affected equipment is assigned.

1. Replace R-106 resistor potentiometer with a similar standard component, N5905-108-9795.

2. Make pen-and-ink correction in the Technical Manual, NAVSHIPS 900,853, Tables 6-1 and 6-3. Delete Navy designation - 634809-20 and insert N5905-108-9795.

SPEAKER-AMPLIFIER TYPE 49620 UNITS

The production of series Speaker-Amplifier Units Type 49131 has ceased and deliveries of this specific unit have been completed. The Speaker-Amplifier Type 49620 units will be furnished for an interim period and shall be used, in lieu of the 49131 series, to fill shipboard allowances.

The design of the Speaker-Amplifier 49131C unit has been slightly modified to accommodate an improved type of speaker unit and will hereafter be identified by the Navy type number 49620. The over-all and mounting dimensions of the 49620 units are identical to those of the 49131C units and they can be installed in any locations or on any existing mounting brackets which have been planned or prepared for the older units. The wiring diagram and parts list are shown in figures 1 and 2.

The Speaker-Amplifier Units Type 49620 do not have blastproof and waterproof speaker cones. These features were waived in this interim unit in favor of improved operation. This fact should be considered when selecting locations for the new units.

The Speaker-Amplifier Type 49620 is considered to be a stop-gap unit and will be discontinued when more suitable units now under development become available. This unit

is intended, primarily, for use on the broadcast entertainment circuit pending availability of the completely new Speaker-Amplifier Unit Type 49545 which will be standard for this circuit; however, due to the unavailability of the new type 50210 amplifier, for use with the type 49546 speaker, it will be necessary also to install the unit on communication circuits in the meantime. Therefore, the 49620 becomes an interim speaker-amplifier for both communication and broadcast entertainment circuits.

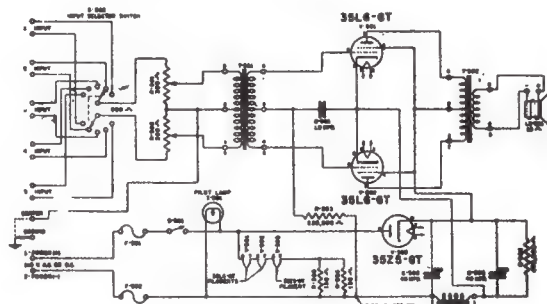


FIGURE 1.--Speaker-amplifier 49620

Schematic symbol	Description	Navy type No.	Magnavox Co. dwg. and part No.	Quantities of spares furnished
C-501	Capacitor, 1.0 mfd. ± 10 percent, 400 v.	C-48595A	16A114-G1	1
C-502	Capacitor, dry electrolytic F.P., 40 mfd., 400 v.d.c.	C-482292	16B10-G1	2
C-503	Same as C-502			
F-501	Fuse, cartridge, 1.0 amp., 250 v.		M-600-G1	40
F-502	Same as F-501			
I-501	Pilot lamp assembly.			
	Socket, candelabra, screw base.		16A83-G1	1
	Lamp, candelabra screw, 115 v., 0.1 a.	CS-5/17	M-603-G1	2
	Reflector, red jewel.		16C45-G1	1
L-501	Reactor, plate filter, 2000 ohms impedance at 60 c.p.s.	C-30764	16A124-G1	1
R-501	Potentiometer, dual-section, each section 300 ohms	CMA632148		
R-502	± 10 percent, wire wound.	CTC632175 CMC632176	16C46-G1	1
R-503	Resistor, 220,000 ohms ± 10 percent, 1/2 watt, insulated type.		16A110-G1	1
R-504	Resistor, 470,000 ohms ± 10 percent, 1/2 watt, insulated type.		16A110-G2	1
R-505	Resistor, 130 ohms ± 10 percent, 1 watt, insulated type.		16A126-G1	1
R-506	Same as R-505.			
V-501	Tube, amplifier, Type 35L6-GT.			4
V-502	Same as V-501			
V-503	Tube, rectifier, Type 35Z5-GT.			2
X-501	Socket, octal base tube.	C-49351	16A111-G1	2
X-502	Same as X-501.			
X-503	Same as X-501.			
S-501	Switch, s.p.s.t., toggle type.	C-24000	16C47-G1	1
S-502	Switch, 2 circuit, 5 positions.		16C48-G1	1

COMMUNICATIONS

NAVSHIPS 900,000.1

SERVICE NOTES

Schematic symbol	Description	Navy type No.	Magnavox Co. dwg. and part No.	Quantities of spares furnished
T-501	Transformer, audio input, center-tapped primary and secondary, d.c. resistance of primary (between terminals 1 and 3): 29 ohms; d.c. resistance of secondary (between terminals 4 and 6): 1884 ohms.	C-301307	16A122-G2	1
T-502	Transformer, audio output, center-tapped primary, d.c. resistance of primary (between terminals 1 and 3): 104 ohms; d.c. resistance of secondary (between terminals 4 and 5): 0.57 ohm.	C-301308	16A123-G2	1
LS-501	Loudspeaker.		16B11-G1	1

HANDSET NT-51007A NOISE-CANCELLING ADAPTER

The Electronics Supply Office has procured a quantity of noise-cancelling adapters for the NT-51007A standard shipboard handset. This adapter, complete with instructions for replacement of the existing microphone element, permits speech to be transmitted clearly while neutralizing unwanted noises. The noise-cancelling adapter which is stocked under FSN N5965-567-7442, provides excellent anti-feedback characteristics.

The Bureau of Ships is currently investigating an NT-51007A handset replacement. This new handset will be a noise-cancelling dynamic microphone and receiver type having a built-in transistorized pre-amplifier. It will be interchangeable with existing handsets as used with Radio Remote Control Units C-1138 ()/UR and C-1207/UR. In the near future, all carbon type microphones, handsets and chest-sets will be replaced with dynamic types for the improvement in audio fidelity. A concurrent investigation is being made for a headset-microphone assembly designed to replace existing bulky and heavy chest sets.

NOISE-CANCELING, DYNAMIC HANDSET H-169/U AND FIELD CHANGE KIT FOR NT-51007A HANDSET

The Bureau of Ships is presently procuring the Single-Sideband Transceiver AN/URC-32 and Transmitter AN/WRT-2. These equipments are being provided with a Noise-Canceling, Dynamic-Type Handset H-169/U and cord CX-1846/U mounted on the front panel.

The H-169/U is essentially a NT-51007A type handset with the carbon-microphone element replaced with a dynamic element, a transistorized pre-amplifier, a noise-canceling mouthpiece, and a dynamic-receiver element.

The Bureau is currently procuring a field change kit for the existing NT-51007A handsets to modify them as equivalents to the H-169/U (See EIB 486). These field change kits are not expected to be available until approximately July 1959.

Through the field change to the NT-51007A and the use of the H-169/U dynamic-type hand sets, improved audio fidelity will be achieved with a resultant improvement in communications.

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****IMPROVEMENT IN THE TYPE COA-66089 ANTENNA SYSTEMS**

Failure of the type COA-66089 antenna system (used with model TBY equipment) due to leakage of water into the box at the base of the vertical radiator has been reported. This difficulty may be overcome by the following means:

- (1) Disassemble the antenna rod, Lucite insulator and Lucite washer.
- (2) Cut a rubber gasket one inch in diameter which will fit around the shoulder on the bottom of the lucite antenna insulator (this requires a 3/4" hole in the center).
- (3) Coat the inside and bottom of the Lucite insulator with Glyptol, also the top of the inside lucite

washer, and assemble with the rubber gasket, placing a coating of Glyptol between the rubber washer and the metal box.

- (4) Make sure that a flat washer and a lock washer are used under the nut on the end of the antenna, and that the nut is drawn up tight.

- (5) Put a ridge of Glyptol around the junction between the antenna rod and the top of the Lucite insulator, and a ridge of Glyptol around the junction between the metal box and the bottom of the Lucite insulator. This insures a water-tight seal around the two possible entrances for moisture.

ORIGINAL**NT-66089:1**

SERVICE NOTES**NAVSHIPS****900,000.1****COMMUNICATIONS****ANTENNA REMINDER - ANTENNA NT-66095**

In EIB No. 413, page 3, there is a statement to the effect that broken bellows in type 66095 antenna should be repaired by an exact replacement. The Electronic Supply Office, Great Lakes, Illinois, now has in stock a quantity of 125 replacement bellows for the type 66095. The bellows are stocked under SNSN N16-B-230001-133.

Failure of the bellows (located at the end of the center rod of the matching unit) in NT-66095 Antenna, requires

exact replacement. This bellows was originally installed to compensate for expansion of the center conductor. If a rigid piece is substituted for the bellows, there is no compensation for expansion.

The original bellows was made by Fulton Sylphon Division of the Rober Shaw Fulton Controls Company, Knoxville, Tennessee; drawing 107681-8.

ORIGINAL**NT-66095:1**